Use of Coblation Technology In Otolaryngology

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About This Book

Coblation or “Controlled ablation” is the current technology being put to use in the field of otolaryngology.

Otolaryngologists have started experimenting with this tool. This book shares the author’s views and experience with this unique tool. Eventhough currently this equipment is extensively used for performing adenotonsillectomy, it has other quite potent uses in rhinology and laryngology. Complete knowledge of the physics of plasma which is responsible for tissue ablation will go a long way in putting this technology to better use. Embracing any new technology involves a short learning curve. This curve should be respected. Similarly coblation too has a learning curve. All coblation surgeries that are described in this book have been personally performed by the author.

This book has been broken down into conveniently learnable chapters. Readers need not go through these chapters in an orderly manner because each chapter is so self contained that they can be considered as separate learning modules.

This book is entirely based on the experience of the author. It also reflects the views of the author about this technology.

This book is published in two formats. One interactive pdf format which needs adobe acrobat reader to enjoy videos embedded and the other without embedded videos.

Caution:

This technology is still in its developmental stage. Various newer types of coblation wands are being introduced by the day. Readers should be as conservative as possible with this technology as it involves a steep learning curve.

About the author

Balasubramanian Thiagarajan is currently professor of Otolaryngology Stanley Medical College Chennai. Tamilnadu India. He has authored many books which are already popular among students and practitioners of otolaryngology.

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Disclaimer

This book is intended for Students and practitioners of Otolaryngology. The technology discussed in this book is still evolving and the last word is not out yet. This book is entirely based on the personal experience of the author in using this technology. Views expressed in this book are entirely based on the experiences of the author. Author also wishes to state that he has no conflict of interest while authoring this book because he has no financial or other interests with the company.

Foreword

I still remember the day 3 years back when Arthrocare representative came to my room and gave a coblator for demo.
It was lying idle in my room for nearly a week before i felt guilty and preformed my first coblation tonsillectomy.
To be very frank it was a disaster. Bleeding was heavy, and I spent a lot of time tying bleeders. It was a frustrating experience to start with. I had videographed the entire surgical procedure. I promptly contacted the Arthrocare representative and expressed my disappointment. After patiently listening to my feelings he said that the next time I use the machine he will be by my side helping me out. Even though the offer left my ego bruised, i took it up because I was keen to give the machine one last chance. I started the surgery (tonsillectomy) with arthocare representative behind me.
He kept guiding me, giving instructions which I followed with lots of irritation. Then it dawned on me. I decided to wipe my slate clean and start with my learing mode activated. It really changed my attitude towards the technology. I started climbing the learning curve the equipment demanded. By 3 months I had used the equipment to such an extent I became familiar with it. One day I operated on a patient with Bilateral abductor paralysis (Kashima's procedure) with the laryngeal wand. The surgery was so comfortable, I was able to complete the entire procedure in half of my regular time duration.

This experience was enough to place order for purchase of coblator. I have been using this equipment extensively for the past 3 years. I wanted to share my experiences with the equipment, this made me write this e book.

This e book has been authored with my own experience gained by using this equipment.

One thing I wish to state is that I am no representative of arthrocare, and I have no stakes in the company.

I am using their name liberally throughout this book because this product is their monopoly.

My advice to potential users of coblation technology:

1. Beware of the steep learning curve this technology demands

2. Consumables i.e. plasma wands are expensive commodities

3. The company advices the user to discard the wand after a single use because of the risk of post op infections associated with repeated use of the same wand

4. Plamsa generation and hence tissue ablation is better if saline irrigation is copious

5. Cold saline causes rich plasma generation and hence better ablation

6. Intermittent pressure to ablation foot pedal gives better ablation result

7. Always start the learning process with a clean slate

8. Since the temperature reached during ablation is around 40 - 70 degrees centigrade there is absolutely no risk of airway fire. Hence it is very useful in performing laryngeal surgeries.

9. It is always prudent to perform a few cases of tonsillectomies using coblation before venturing to laryngeal surgeries

10. It is commonly being used to perform tongue base reduction and palatal surgeries which are otherwise difficult and quite messy to perform. It is hence considered to be a potent tool in the treatment of obstructive sleep apnoea syndrome.

Contents

Introduction

The technology of using plasma to ablate biological tissue was first described by Woloszko and Gilbride [1]. By their pioneering work in this field they proved that radio frequency current could be
passed through local regions of the body without discharge taking place. Radio frequency technology for medical use (for cutting, coagulation and tissue dessication) was popularized by Cushing and Bovie [2]. Cushing an eminent neurosurgeon found this technology excellent for his neurosurgical procedures. First use of this technology inside the operating room took place on october 1st 1926 at Peter Bent Brigham Hospital in Boston, Massachusetts. It was Dr Cushing whoremoved a troublesome intracranial tumor using this equipment.

The term coblation is derived from "Controlled ablation". This procedure involves non-heat driven process of soft tissue dissolution using bipolar radiofrequency energy under a conductive medium
like normal saline. When current from radiofrequency probe pass through saline medium it breaks saline into sodium and chloride ions. These highly energized ions form a plasma field which is
sufficiently strong to break organic molecular bonds within soft tissue causing its dissolution.

Coblation (Controlled ablation) was first discovered by Hira V. Thapliyal and Philip E. Eggers. This was actually a fortuitous discovery in their quest for unblocking coronary arteries using electrosurgical energy. In order to market this emerging technology these two started an upstart company ArthroCare. Coblation wands were exhibited in arthroscopy trade show during 1996.
Initially coblation technology was used in arthroscopic surgeries immensely benefiting injured athelets.
Coblation is non-thermal volumetric tissue removal through molecular dissociation. This action is more or less similar to that of Excimer lasers. This technology uses the principle that when electric current is passed through a conducting fluid, a charged layer of particles known as the plasma is released. These charged particles has a tendency to accelerate through plasma, and gains energy to break the molecular bonds within the cells. This ultimately causes disintegration of cells molecule by
molecule causing volumetric reduction of tissue.
Medical effects of plasma has spurred a evolution of new science "Plasma Medicine". It is now evidently clear that Plasma not only has physical effects (cutting and coagulation) on the tissues but also other beneficial therapeutic effects too. Plasma not only coagulates blood vessels but also decontaminates surgical wound thereby facilitating better wound healing. Therapeutic application of plasma assumes that plasma discharges are ignited at atmospheric pressure.

Plasma Medicine:

This field of medicine can be subdivided into:

1. Plasma assisted modification of biorelevant surfaces
2. Plasma based decontamination and sterilization
3. Direct therapeutic application

Plasma assisted modification of biorelevant surfaces:

This technique is used to optimize the biofunctionality of implants, or to qualify polymer surfaces for cell culturing and tissue engineering. For this purpose gases that do not fragment into polymerisable intermediaries upon excitation should be used. Gases that do not fragment include air, nitrogen, argon, oxygen, nitrous oxide and helium. Exposure to such plasma leads to new chemical functionalities.

Plasma based decontamination and sterilization:

Not all surgical instruments can be effectively sterilized using currently available technologies.
This is due to the fact that plastics cannot be effectively be sterilized by conventional means as it could get degraded on exposure to steam and heat. Plasma discharges have been found to be really
useful in this scenario because of its low temperature action. The nature of plasma actions on bacteria extends from sublethan to lethal effects. Sublethal effects cause bacteriostatic changes, while lethal effects cause bacteriocidal changes.

Growth of drug resistant bacteria MRSA in hospital environment poses a great challenge in sterilization efforts. Ideal sterilization mechanism should be fast and efficient. Studies reveal that plasma devices perform this action rather effortlessly [6].

Direct therapeutic applications:

Antifungal therapy: Plasmas can be employed to treat fungal infections. Common fungal ailments like T pedis can be managed using plasma technology [7].

Dental care: Periodontal infections are common in older age group patients and pregnant mothers. Plasmas have an ability to penetrate microscopic openings between teeth and gum destroying the offending organism [8].

Management of chronic wound: Eventhough plasma does not play direct role in wound healing, its bactericidal and fungicidal effects helps in wound healing [9].

Surgeries: Currently plasma technology is being used to perform blood less surgeries like tonsillectomy etc.

Types of cold atmospheric Plasma (CAP):

CAP's basically are of 3 types:

1. Direct Plasma - It has a single needle electrode which generates plasma source. It is useful in managing skin lesions.

2. Indirect Plasma - Plasma is generated between two electrodes and is transported to the area of application in an entrained gas flow. This is the commonly used technology in plasma wands currently used in coblation surgical procedures.

3. Hybrid plasma - combines the technique of both direct plasma and indirect plasma. Grounded wire mesh electrode is useed for this purpose.

A broad spectrum of plasma sources dedicated for biomedical applications have been developed.

These include:

1. Plasma needle [3]
2. Atmospheric pressure plasma plume
3. Floating electrode dielectric barrier discharge
4. Atmospheric pressure glow discharge torch
5. Helium plasma jets
6. Dielectric barrier discharge
7. Nano second plasma gun

Figure showing plasma needle. The glow is cold enough to be touched

Dielectric barrier discharge:

This is the technology used in therapeutic coblators. This is characterised by the presence of atleast one isolating layer in the discharge gap [4] .

Plasma:

The effectiveness of coblation technology is due to the formation of plasma. Chemically speaking plasma is a form of ionized gas. The term ionized indicate the presence of atleast one unbound electron. The presence of electrons and ions makes plasma an electrically conductive media better than copper or gold.

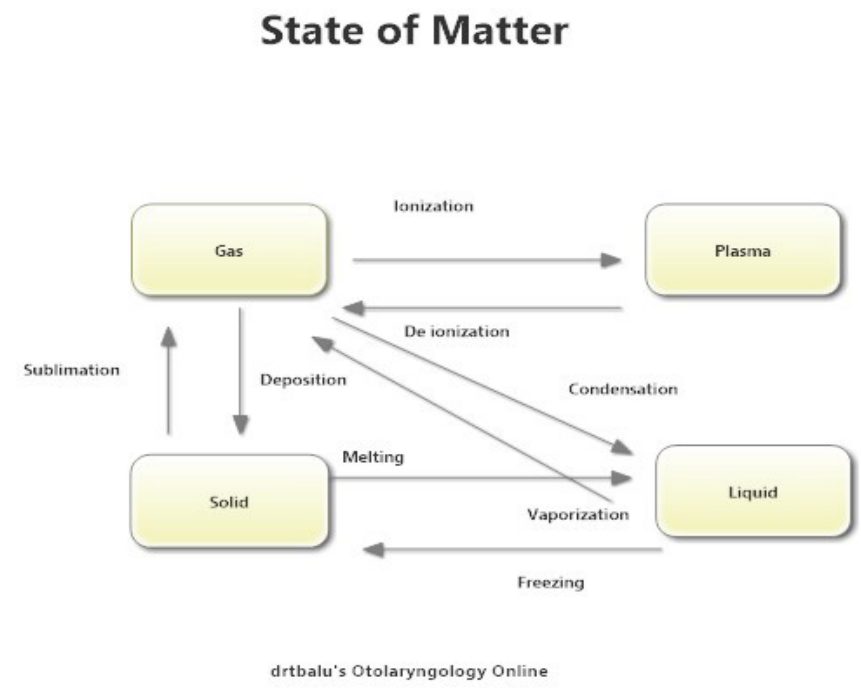


Diagram showing the various states of matter and their transitions with increasing internal system energy

Plasmas are generated by electrical discharges in direct contact with liquids. Electric underwater discharges create the following phenomena:

1. Strong electrical field
2. Shock mechanical wave
3. Free radical production
4. Strong UV radiation
5. Production of ozone if oxygen is present in the system

K.R. Stalder and J. Woloszko did pioneering work in formation of microplasma produced by electrical discharges in saline environment. This microplasma caused surgical ablation of tissues and improved surgical outcomes.

Wand is the electrode (disposable) used in coblation as a knife to cause ablation.

Image showing coblator wand with three electrodes separated by ceramic

For effective use of this technology for surgical procedures the plasma generated by the wand / electrode should be uniform.[5] The uniformity of plasma can be ensured by:

1. Increasing preionization of the gas thus ensuring generation of more avalanches
2. Shortening of voltage rise time

Therapeutic applications of plasma:

Plasma treatment is known to cause coagulation of large bleeding areas without inducing additional collateral tissue necrosis. Other methods causing coagulation act thermally producing a necrotic zone around the treated spot. Non thermal coagulation is caused due to release of Na and OH ions which causes release of thrombin.

Coblation technology is widely used in the field of otolaryngology for performing:

1. Tonsillectomy
2. Adenoidectomy
3. UPPP
4. Tongue base reduction
5. Turbinate reduction
6. Kashima procedure for bilateral abductor paralysis
7. Papilloma vocal cords

Technology overview:

Coblation technology is based on non heat driven process of soft tissue dissolution which makes use of bipolar radio frequency energy [1]. This energy is made to flow through a conductive medium like normal saline. When current from radiofrequency probe passes through saline medium it breaks saline into sodium and chloride ions. These highly energized ions form a plasma field strong enough to break organic molecular bonds within soft tissue causing its dissolution. Since 1950's high frequency electrosurgical apparatus have been in use. In conventional high frequency apparatus heat is made use of to cause tissue ablation and coagulation. The heat generated happens to be a double edged weapon causing collateral damage to normal tissues. Coblation is acutally a benefical offshoot of high frequency radio frequency energy. The excellent conductivity of saline is made use of in this technology. This conductivity is responsible for high energy plasma generation.

Stages of plasma generation:

First stage – (Vapour gas piston formation):
This is characterised by transition from bubble to film boiling. This decreases heat emission and causes increase in surface temperature.
Second stage – Stage of vapour film pulsation:
Tissue ablation occurs during this stage.
Third stage – Reduction of amplitude of current across the electrodes.

Fourth stage : Dissipation of electron energy at the metal electrod surface
Fifth stage (stage of thermal dissipation of energy): This stage is essentially due to recombination of plasma ions, active atoms and molecules. These stages explain why coblation is effective if applied intermittently. This ensures constant presence of stage of vapour film pulsation which is important for tissue ablation.

Effect of plasma on tissue:
The effect of plasma on tissue is purely chemical and not thermal. Plasma generates H and OH ions. It is these ions that make plasma destructive. OH radical causes protein degradation. When coblation is being used to perform surgery the interface between plasma and dissected tissue acts as a gate for charged particles.

In nutshell coblation causes low temperature molecular disintegration. This causes volumetric removal of tissue with minimal damage to adjacent tissue [10]. (Collateral damage is low).

Differences between coblation and conventional electro surgical devices

	Coblation Devices	Conventional Electro surgical Devices
Temperatures	40 ° C – 70 ° C	400 ° C – 600 ° C
Thermal penetration	Minimal	Deep
Effects on Target tissue	Gentle removal / Dissolution	Rapid heating, charring, burning and cutting
Effects on surrounding tissue	Minimal dissolution	Inadvertant charring / burning

Electrocautery:
This involves direct current. Electrons flow only in one direction and they dont enter the patient's body. High tissue temperatures are reached causing lots of collateral damage.

Monopolar diathermy:
Active electrode is located in the surgical equipment. Return electrode is the diathermy earth pad placed on the patient. The generator directs current from the active electrode, through the patient's body, to the grounding electrode and then back to the generator. Good for heavy bleeders.

Bipolar diathermy:
Conventional bipolar cautery - current is delivered through a forceps like device. One prong serves as active electrode, while the other serves as return electrode. Current flows from one prong through the tissue to the other prong.
Coblator:
Active and return electrodes are housed in the same shaft.

Operates at low temperature and frequency. Current has to travel only through a shorter path and does not travel through the patient.

Components of Coblation system:

1. RF generator
2. Foot pedal control
3. Irrigation system
4. Wand

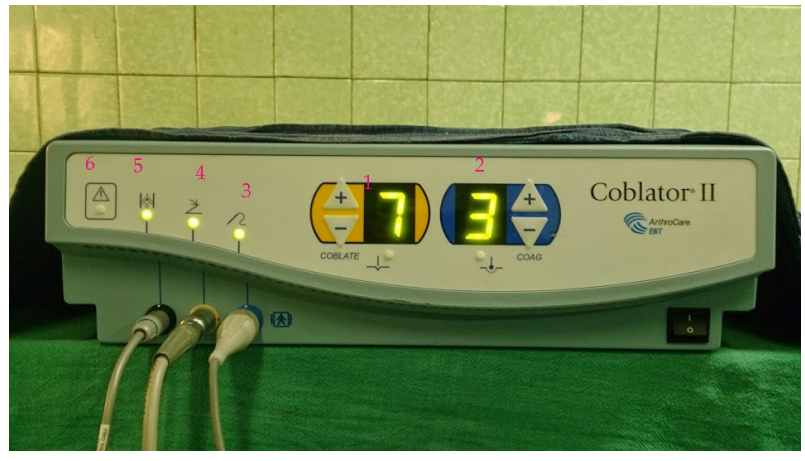


Image of RF generator

Image of irrigation controller

Image showing the pedals

RF generator:
This generator generates RF signals. It is controlled by microprocessor. This generator is capable of adjusting the settings as per the type of wand inserted. It automatically senses the type of the wand and adjusts settings accordingly. Manual override of the preset settings is also possible. Two settings are set i.e. coblation and cauterization. For a tonsil wand the recommended settings would be :

Coblation – 7 (plasma setting)
Cauterization – 3 (Non plasma setting)
Similarly the foot pedal has two color coded pedals. Yellow one is for coblation and the blue one is for RF cautery. This device also emits different sounds when these pedals are pressed indicating to the surgeon which mode is getting activated.

Even though coblation is a type of electro surgical procedure, it does not require current flow through the tissue to act. Only a small amount of current passes through the tissue during coblation.
Tissue ablation is made possible by the chemical etching effect of plasma generated by wand. The thickenss of plasma is only 100-200 μm thick around the active electrode.

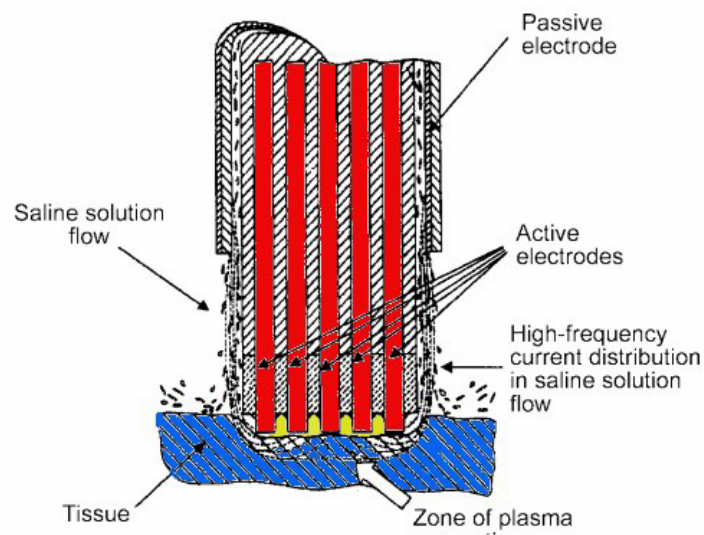
Otolaryngological surgeries where coblation technology has been found tobe useful include:

1. Adenotonsillectomy
2. Tongue base reduction
3. Tongue channeling
4. Uvulo palato pharyngoplasty
5. Cordectomy
6. Removal of benign lesions of larynx including papilloma
7. Kashima's procedure for bilateral abductor paralysis
8. Turbinate reduction
9. Nasal polypectomy
5. Cordectomy
6. Removal of benign lesions of larynx including papilloma
7. Kashima's procedure for bilateral abductor paralysis
8. Turbinate reduction
9. Nasal polypectomy

There are different types of wands [11] available to perform coblation procedure optimally.
Tonsil and adenoid wand is the commonly used wand for all oropharyngeal surgeries. This wand will have to be bent slightly to reach the adenoid.
Laryngeal wand is of two types. Normal laryngeal wand which is used for ablating laryngeal mass lesions. Mini laryngeal wand is used to remove small polyps from vocal folds. The main advantage of mini laryngeal wand is its ability to reach up to the subglottic area.
Nasal wand and nasal tunelling wands are commonly used for turbinate reduction.
Seperate tunelling wands are available for tongue base reduction.

Equipment specification:

1. Modes of operation – Dissection, ablation, and coagulation
2. Operating frequency – 100 khz
3. Power consumption – 110/240 v, 50/60 Khz



Diagramatic representation of coblation wand

Coblation wand has two electrodes i.e. Base electrode and active electrode. These electrodes are separated by ceramic. Saline flows between these two electrodes. Current generated flows between these two electodes via the saline medium. Saline gets broken down into ions thereby forming active plasma which ablates tissue.

Efficiency of ablation can be improved by:

1. Intermittent application of ablation mode
2. Copious irrigation of normal saline
3. By using cold saline plasma generated becomes more efficient in ablating tissue. Cold saline can be prepared by placing the saline pack in a refrigerator over night.

Coblation is a smokeless procedure. If smoke is seen to be generated during the procedure it indicates the presence of ablated tissue in the wand between the electrodes. Hence a smoking wand should be flushed using a syringe to remove soft tissue ablated particles between the electrodes.

The generated frequency from coblator should atleast be 200 kHz since frequencies lower than 100 kHz can cause neuromuscular excitation when the wand accidentally comes into contact with neuromuscular tissue.

Coblator has been designed to operate in two different modes:

Ablation mode: As the RF controller setting is increased from 1 to 9 in the coblation mode, the performance of the wand transitions from thermal effect to ablative effect due to creation and increase in the intensity of plasma. When the controller setting in the coblation mode increases the plasma field increases in size and the thermal effect decreases accordingly.

Coagulation mode: All coblation wands have been designed to operate in coagulation mode for hemostasis during surgery. Since the wand is bipolar in nature, it sends energy through the desired tissue area, through resistive heating process.

References:

1. J. Woloszko et al., Lasers in Surgery: Advanced Characterization, Therapeutics, and Systems X, R. R. Anderson et al., Eds. Bellingham, WA: SPIE, 2000, vol. 3907, pp. 306–316
2. H. Cushing and W. T. Bovie, "Electrosurgery as an aid to the removal of intracranial tumors," Surg. Gynecol. Obstet., vol. 47, pp. 751–784, 1928.
3. M. Laroussi and X. Lu, "Room-temperature atmospheric pressure plasma plume for biomedical applications," Applied Physics Letters 87 (11) (2005).
4. Ulrich Kogelschatz, "Dielectric-Barrier Discharges: Their History, Discharge Physics, and Industrial Applications," Plasma Chemistry and Plasma Processing 23 (1), 1-46 (2003)
5. B. Qi, Ren C., Wang D., Li SZ., Wang K., and Zhang Y., "Uniform glowlike plasma source assisted by preionization of spark in ambient air at atmospheric pressure," Applied Physics Letters 89, 131503 (2006).

6. Grundmann H, Aires-de-Sousa M, Boyce J and Tiemersma E 2006 Emergence and resurgence of meticillinresistant Staphylococcus aureus as a public-health threat Lancet 368 874–85

7. Morfill G et al 2009 Nosocomical infections—a new approach towards preventive medicine using plasmas New J. Phys. 11 115019

8. Klein L and Gibbs R 2004 Use if microbial cultures and antibiotics in the prevention of infection-associated preterm birth AJOG 190 1493–502

9. Etufugh C N and Phillips T J 2007 Venous ulcers Clin. Dermatol. 25 121–30

10. S.V Belov, Use of High-Frequency Cold Plasma Ablation Technology for Electrosurgery with Minimized Invasiveness,Biomedical Engineering,Vol38,no2,2004,pp80-85.

11. V.N Sergeev, S.V.Belov Coblation Technology:a New Method for High Frequency Electrosurgery,Biomedical Engineering,Vol37,No 1,2003,pp22-25.

Coblator Set-up

The following are the parts of Coblator:

1. Controller unit

2. Flow control Unit

3. Foot control unit

Figure showing the back side of controller unit

1. Alarm volume adjustor knob

2. Coolant fan vent

3. Slot for power cable

Controller Unit:

This is nothing but a Radio frequency generator. This unite generates RF signals. It is controlled by a microprocessor chip. This unit is capable of adjusting settings according to the type of wand inserted. It has also features of manual over ride of automatic settings.

For example automatic settings for a tonsil wand would be:

Coblation - 7 (Plasma setting)
Cauterization - 3 (non plasma setting)

Controller input power requirements:

Voltage	90-120 V AC
Frequency	50-60 Hz
RMS current	8 Amps Max
Fuse rating	T8 amps 250 V AC for 120 VA

Controller power output

Fundamental frequency	100 kHz
Voltage range	0-300 VMS @ 100 kHz
Maximum power output	400 watts @ 250 Ohms
Operating Temperature	10^{0} c to 40^{0} C

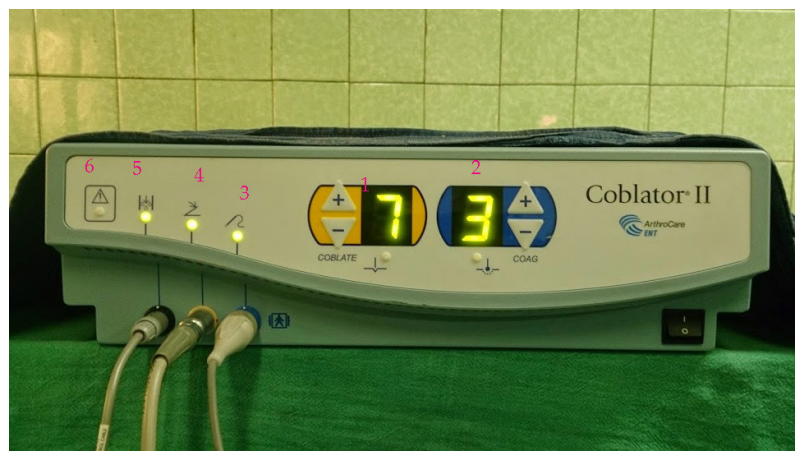


Figure showing the front side of controller unit

1. Coblation setting
2. Coagulation setting
3. Wand port
4. Foot pedal port
5. Flow control unit port
6. Hazard lamp

Setting up coblator system steps:

1. Power cable is plugged into the rear port of the console

2. Power switch infront of the console is switched on

Figure showing the power switch on the front side of console

3. Connect the foot pedal and the wand cable to the corresponding receptacle on the front of the controller. As soon as the wand is connected to the receptacle, the type of wand would be sensed by the microprocessor inside and console and the default settings of the particular type of wand would be displayed. If for some reason the default settings need to be adjusted then it can be done using the up / down arrows present on either side of the settings displayed.

4. For using wands along with saline irrigation, the flow control valve unit is clamped to the IV stand. 500ml / 1000 ml normal saline is hung at a height of 3 feet above the patient for ensuring optimal saline flow.

5. Plug one end of the flow control cable into the rear of flow control valve unit, and the other end into the receptacle on the front of the controller.

6. Connect the IV tubing from the saline bottle to the wand after passing through the pinch valve of the flow control unit. Valve switch is pressed upwards so that green light is illuminated to open the pinch valve.

7. Open the irrigation tubing roller clamp to manually start the saline flow. The saline can be seen coming out of the tip of the wand. The drip rate is adjusted by using the roller clamp of IV tube to the desired level. The valve switch is pressed down to auto position.

Image showing flow control unit clamped to the saline stand. Note the IV cable passing through a pinch cock valve

Saline should only drip when the surgen steps on the pedal. Non stop flow of saline through the wand indicates that the saline tube has not properly passed through the pinch cock valve of the flow control unit.

8. Connect the OR suction tubing to the suction tubing of the wand. Recommended suction pressure should ideally be between 250-300 mm of Hg.

During surgery the tip of the wand emits a glow which is known as the plasma. Plasma generation is necessary for tissue ablation. The color of the glow is dependent on the type of medium used. Use of sodium chloride (Normal saline) solution as the medium causes yellow colored glow (plasma) while potassium chloride medium causes pinkish blue plasma glow.

During coblation surgery the tissue could be seen turning brown. This does not indicate heat induced charring but tissue oxidation.

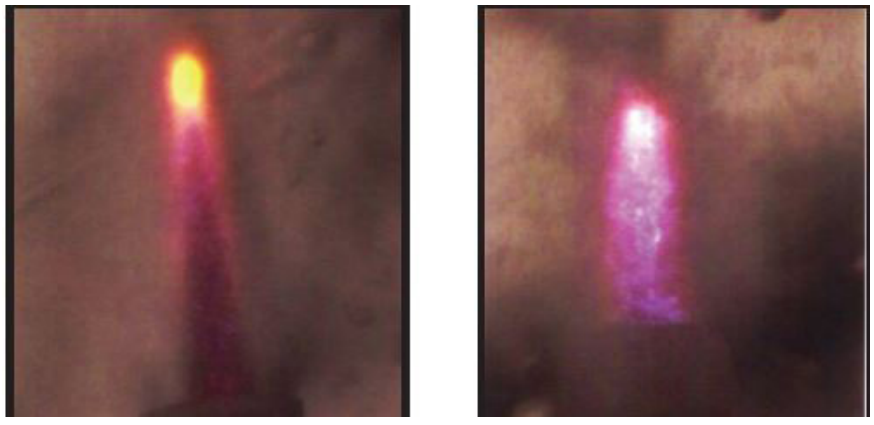


Figure showing the two types of plasma glow depending on the medium

During surgery copious irrigation with normal saline increases the quality of plasma generated. Sometimes if the quanity of saline irritation needs to be increased for better ablation of tissue. In this scenario the flow can be increased by applying direct pressure to the saline bag.

[1]

Figure showing tonsil wand

Typical tonsil wand (Evac 70) has ports for irrigation, suction and a connecting cable which is connected to the front side of the console.

During surgery it could be noticed that the alarm sound emitted when ablate pedal is different from that emitted when the coagulate pedal is pressed. Surgeon who regularly use this equipment for surgery could just by listening to the sound emitted by the alarm on pressing either of these pedals will know which is being pressed just by hearing the sound.

Reference:

While preparing this chapted the author has relied extensively on the coblation technology white paper published by Arthrocare.

Wands

Introduction:

There are different wands available for different surgical procedures. These wands include:

1. Tonsil wand
2. Laryngeal wand
3. Microlaryngeal wand
4. Nasal wand
5. Needle wands for tongue base reduction and turbinate reduction

Tonsil wands:

This wand is also known as Evac 70 wand. It has a triple wire molybdenum electrode. This triple wire electrode is very useful for tissue ablation. Its bipolar configuration suits efficient hemostasis. The shaft is malleable and hence can be bent to suit various anatomical configurations of oral cavity. It can also be bent so much that adenoids can be reached via the oral cavity route under the soft palate. It has integrated suction and irrigation facility. Normal saline is used for irrigation purposes. Normal saline acts as a medium through which Radio frequency current passes causing release of plasma. This integrated irrigation and suction facility obviates the necessity of separate suction during surgical procedures.

Tonsil wand happens to be the work horse of the entire system. It is also the most commonly used wand. The basic advantages of tonsil wand are:

1. Plasma generated by the electrodes are optimized for adequate tissue ablation

2. The depth of injury is very less and hence there is no collateral tissue damage

3. The temperature generated between the electrodes is 40-70° C. This temperature does not cause airway fire and it is hence safe to use.

4. The presence of multiple electrodes ensures quick and stable establishment of plasma layer, maintains the stability of the plasma layer and also maximizes the plasma layer.

EVac T&A:
This is the most aggressive of the coblator wands. It behaves like tonsil suction wand because of its ability to simultaneously dissect, ablate and remove tissue. It has a stronger suction with a larger electrode. It is longer and more malleable than the classic EVac 70 wand hence can be used to remove adenoid tissue.

Figure showing EVac 70 tonsllectomy wand

Close up view of EVac 70 wand showing the triple wire electrode

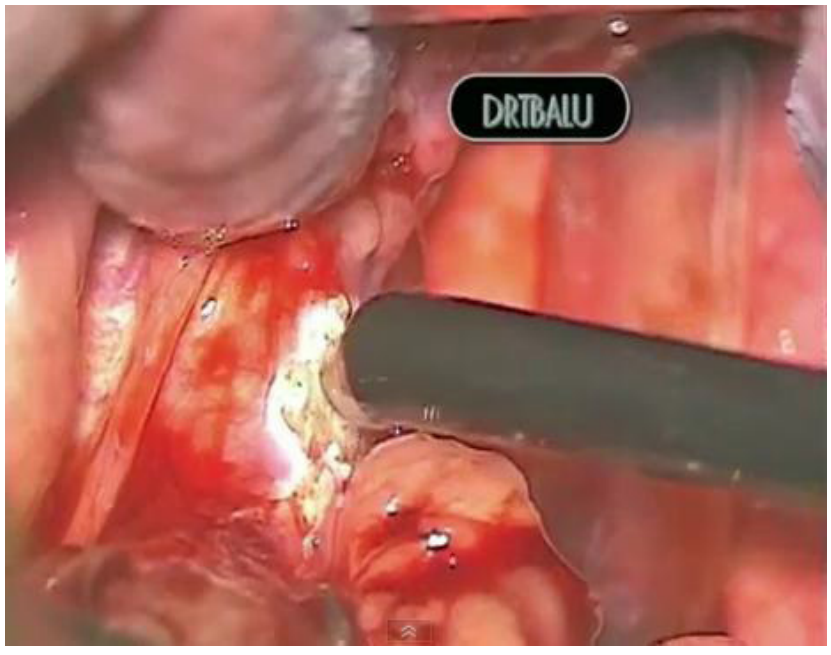


Image showing Tonsil wand (E-Vac 70) in action

Major advantage of Evac 70 group of wands is that the wand shaft is malleable and thus can be bent to accomodate variable patient anatomy. This feature also helps in accessing the choanal area during adenoidectomy.

EVAC 70 XTRA:

This wand is a variation of the classic EVAC 70 tonsil wand in that it is efficient in ablating tissue. Key features of this wand include:

* It has a triple wire electrode configuration which efficiently removes both adenoid and tonsillar tissue.

* It has integrated suction and irrigation ports making it a convenient all in one tool during surgery

* Its shaft is about 6 inches longer than that of classic Evac 70 wand making it suitable for accessing choanal area during adenoidectomy.

* The shaft is also malleable hence it can be bent confirming to the varying oropharyngeal anatomy of the patient.

Figure showing the ports and electrodes of EVAC 70 XTRA wand

Procise Max wand:

This wand is suited for rapid ablation of tissue with good hemostasis. This wand is particularly useful during adenoidectomies where rapid ablation of tissue with adequate hemostasis is a must. It has a flat screen electrode configuration with high power suction port. Its ablation is about 20% more than that of EVAC 70 Ultra. Its improved suction capability prevents clogging of the wand by ablated tissue. This wand is slightly thinner than that of EVAC 70 wand thereby provides improved visibility during surgeries. Since it is also malleable it can be bent to confirm to anatomical variations of the patient's oropharynx.

Figure showing the tip of Procise Max wand along with its flat screen electrode

Excise Pdw Plasma wand:

This is considered by many surgeons to be a fine dissecting instrument which delivers the effect of coblation with the tactile feel of monopolar cautery. By design it has a single wire-loop electrode, with thinner and smaller shaft length which facilitates better surgical field visualisation.

Advantages of Excise Pdw Plasma wand:

1. It is a fine dissector, hence excellent surgical plane can be created and maintained.
2. Depth of thermal injury is less
3. Coagulation mode is useful to coagulate bleeders
4. Its integrated suction and irrigation features completes the system
5. Very useful in performing tonsillectomy and Uvulo palato pharyngo-plasty.

Figure of Excise Pdw Plasma wand showing its single wire loop electrode

EVAC 70 HP Xtra Plasma wand:

This wand is slightly longer and more malleable than the conventional EVAC 70 wand. It has a triple electrode configuration. Because of its extra length and malleability it is very useful during adenoidectomy, especially while removing tissue close to the choanal area.

Figure showing EVAC 70 HP Xtra Plasam wand

Reflex Ultra PTR wand:

These wands are used for turbinate reduction surgeries. These wands are designed to suit varying anatomy of nasal turbinates. It is thin and sleek. It is provided with visual markers to ascertain the depth of insertion before actually ablating the tissue. These depth markers are colored orange for better visibility.

Tip diameter - 1.3 mm

Length of the electrode area - 10.5 mm

Distance from tip to bend - 42.6 mm

Number of visual markers - 2

Color of visual markers - Orange

Figure showing Reflex Ultra PTR wand

Figure showing tip of Reflex Ultra PTR wand

Turbinate reduction wands have the following default setting:

Coblate - 4
Coagulate - 2

Coblation channeling technique is used to reduce the size of the turbiantes. This same technique is also used for tongue base reduction surgical procedures. Major advantage of these tunneling technique is that only submucosal tissue is ablated sparing the mucosal surface. Multiple channels can be created for optimal tissue ablation.

Reflex ultra 45 wand:

These wands have slightly longer shaft length to cater to large turbinates. Both anterior and posterior portions of the turbinate can be ablated using this wand. Since it is longer than Reflex Ultra PTR wand it has three depth markers. These markers are colored black.

Technical specifications:

Tip diameter - 1.7 mm

Length of electrode area - 10 mm

Distance from the tip to bend - 56.1 mm

Number of depth markers - 3

Color of depth markers - Black

Figure showing Reflex Ultra 45 wand

ReFlex Ultra SP:

This is a soft palate wand. This is designed for rapid dissection and channeling of soft tissue during Uvulo palato pharyngoplasty and other snoaring treatment procedures. It has an adjustable saline delivery sheath which makes it suitable for cutting and submucosal tissue shrinkage if desired. It has a distal ablative electrode and a proximal thermal electrode. This feature helps the wand to cut and shrink tissue simultaneously.

Default setting of this wand is:

Coblate - 4

Coagulate - 2

Image showing the tip of Reflex Ultra SP wand

Reflex Ultra 55 wand:

This is also a soft palate wand. This wand also has a distal ablative electrode and proximal thermal electrode. This wand can also be used for channeling procedures of soft palate.

It is bent at 55 degrees which follows the curvature of soft palate.

Default setting of this wand is:

Coblate - 4

Coagulate - 2

PROcise EZ View wand:

This wand is used for nasal surgeries. This wand offers all the benefits of coblation technology in a small diameter device. This wand integrates ablation, irrigation, suction and bipolar coagulation. Its unique curvature and the tip adds to the precision and visibility during the surgical procedure.

Image of PROcize EZ View wand

Default settings:

Coblate - 7

Coag - 3

Coblation assisted nasal polypectomy is associated with a significant reduction in blood loss when compared to that of debridement[1]. Coblation Assisted FESS (CAFESS) is a new technique of treatment for chronic sinusitis and nasal polypi. It is currently holding out lots of promise [2]

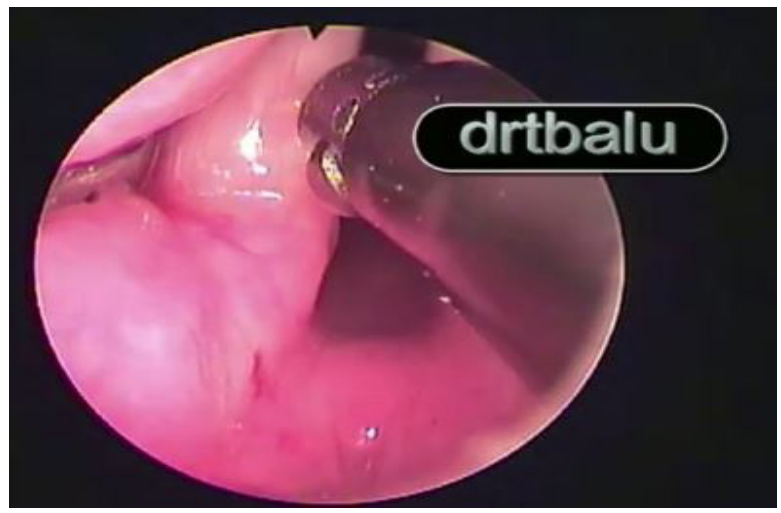
Limitations of coblator in nasal surgeries is largely caused by the size of the wand and the saline delivery system. Increasing the amount of irrigation delivered will improve the efficiency of the system. The shaft width of PROcise EZ view wand is 50% less than that of [3]Evac 70 wand. To improve irrigation 1 litre saline bag should be used.

PROcise LW:

Coblation technology can be used in laryngeal surgeries like removal of laryngeal polyp, cysts. This technology can also be used to perform Posterior cordotomy (Kashima's procedure) in patients with bilateral abductor paralysis. Major advantage of this techology in laryngeal surgery is the absence of airway fire risk [4]. The shaft is malleable.

It has a screen electrode which is capable of swiftly debulking the target tissue. Its malleable shaft adapts to the patient anatomy.

Image showing PROcise LW wand



Laryngeal wand in action

PROcise MLW Plasma Wand:

This wand has been designed for precise controlled removal of laryngeal and subglottic lesions. This wand is ultra slim and is suited for working inside small anatomy. It provides ablation, coagulation, irrigation and suction capabilities in one single versatile device.

Figure showing MLW wand

It has a single wire active electrode configuration. It provides pinpoint precision for ablation process. There is no risk of airway fire. Its extended length increases the field of vision. It also allows anterior commissure to be reached.

Working length of shaft is: 19 cms
Shaft outer diameter is 2.8 mm

Default settings:
Coblate - 7
Coagulate - 3

References:

1. http://dx.doi.org/10.2500/ajra.2009.23.3330

2. http://www.unboundmedicine.com/medline/citation/22384570/[Preliminary_clinical_investigation_of_coblation_assisted_functional_endoscopic_sinus_surgery_for_chronic_sinusitis_and_nasal_polyps]_

3. http://www.sbccp.org.br/arquivos/LG-2012-02-Early-Experience.pdf

4. Smith LP, Roy S. Operating room fires in otolaryngology: risk factors and prevention. Am J Otolaryngol. Article in press (Epub 2010 Apr 14).

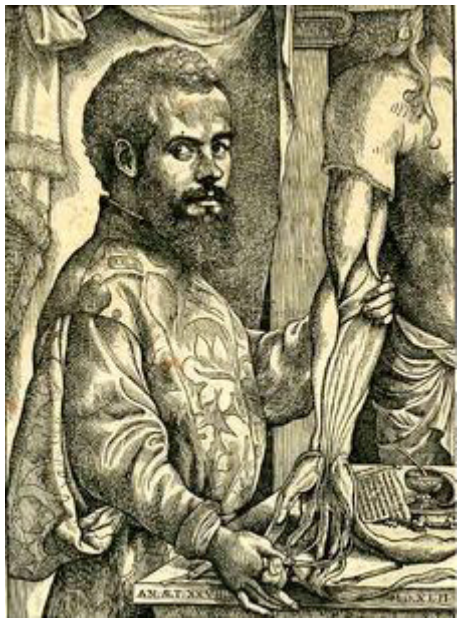
Coblation Tonsillectomy

History:

Tonsillectomy is a surgical procedure which involves removal of palatine tonsils.
According to Hindu script written by Sishrutha [1], it was practised in India 3000 years ago. He even goes to the extent of describing the actual procedure. According to his description tonsillectomy dissection was performed using surgeon's finger nails. The sharp nail of the index finger was used to dissect the tonsil. It is really worthwhile looking down memory lane, savouring our past and visualizing the path treaded by our forefathers.

What is in a name?

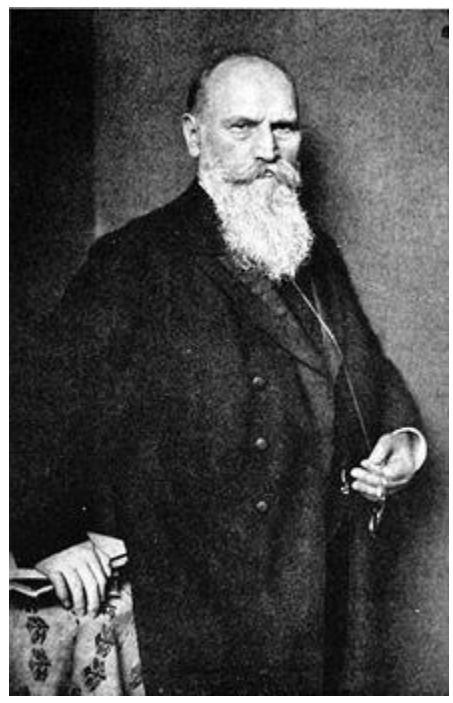
This is the common question thrown at etymologists. Let me assure you there are lot of hidden things in a name.
Tonsa – This word is derived from Latin word meaning "Oar"
Greek used the term amygdala to describe tonsils. "Amygdala means almond shaped".
It was Andreas Vesalius of Brussels who first described in detail the anatomy of pharyngeal tonsils. He even described in detail about its blood supply also.



Portrait of the famous anatomist Andreas Vesalius

He is referred to as the founder father of modern human anatomy. He was the first person to challenge the great Galen. He believed in seeing and verifying the facts himself. He methodically performed extensive anatomical dissections and made excellent diagrams of the same. On top of it all he was an excellent teacher and inspirer.

In 1763 Duverney the renowned French anatomist described in detail the anatomy of pharyngeal area.
It was the German anatomist Heinrich Wilhelm Gottfried von Waldeyer-Hartz who described in detail the anatomy of waldayer's ring (Lymphoid follicles) around the air and food channels. He also coined the term "Waldayer's ring" to designate the various lymphoid elements surrounding the air and food passages. His brilliant treatise titled "Waldayer's ring" was published in 1921 [2].



Portrait of Heinrich Wilhelm Gottfried von Waldeyer-Hartz

It was the Roman surgeon Cornélio Celsus who is credited with performing the first documented tonsillectomy procedure during first century B.C. He is also fondly addressed as the Roman version of Hippocrates. It is a real pity that only 8 of his manuscripts have been preserved. He was supposed to be contemporary of Agustus Caeser. Most of his manuscripts were burnt down when the great library of Alexandria was burnt during the regime of Julius Caeser. According to Leonardo da Vinci Celsus was a magician with knife.

In one of his books Celsus [3] describes meticulously the methods he followed while performing tonsillectomy. He also describes how he used a mixture of vinegar and milk to stop bleeding. He is also forthright in describing that his potion to stop bleeding during tonsillectomy failed on numerous occasions.

1

Portrait of the Roman surgeon Cornélio Celsus

Cornélio Celsus was the first surgeon to categorize the various indications of tonsillectomy. According to him the following were considered to be indications for the procedure [4]:

1. Bed wetting in children
2. Noisy breathing during sleep
3. Voice changes – He beleived that by performing tonsillectomy he can sweaten ones voice

It was Aetius of Amida a Byzantine physician who described the medical management of tonsillar infections. He described a mixture containing frog fat and certain vegetable oils as a therapeutic modality. He is credited with authoring the first book on medical therapeutics. Egyptians during middle ages perfected an art of performing tonsillectomy. Egyptian surgeons passed a thread around the tonsil, knotted it like a noose. By contracting the noose they were able to excise the tonsil as well as minimize the incidence of bleeding. Threads used for this purpose were made of Egyptian cotton.

Tightening of this thread was performed on a daily basis till the tonsil was chocked off its blood supply necosed and fell on its own.

Instruments used in Tonsillectomy surgery:

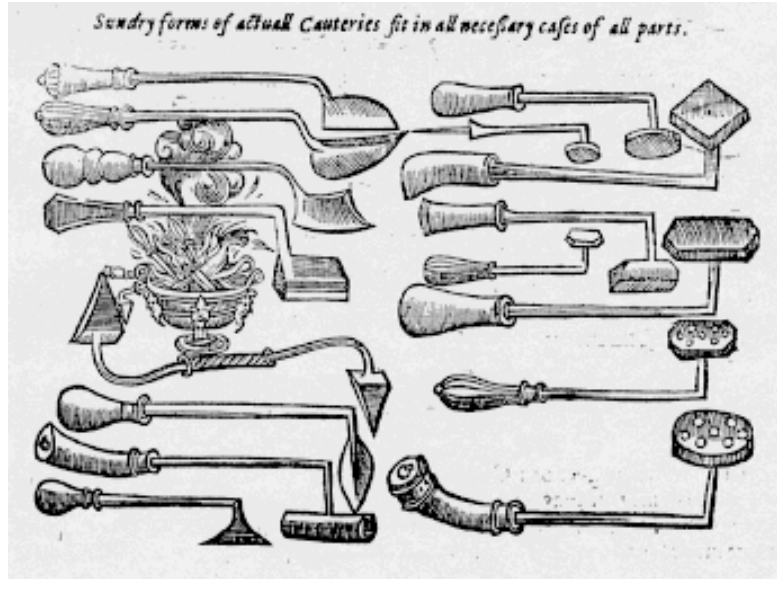
Till about 16 th century there was a lull. The procedure of tonsillectomy was abandoned as it was too dangerous to perform.
It was Paré, in 1664 who designed a special spherical instrument which could be used to strangle the blood supply of uvula and perform uvulectomy. Paré, was trained as a Barber surgeon and was working in Turin province of France. During his period wars were fought with fire arms and he was forced to deal with sharpnel wounds. He even considered firearms to be his worst enemy. When ever possible he never forgot to condemn the use of fire arms in battle.

His famous quote against firearms ran like this:

“Wherefore we all of us rightfully curse the author of so pernicious an engine; On the contrary praise those to the skies, who endeavor by words and pious exhortations to [dissuade] kings from their use.”

He also pioneered the design of various useful surgical equipments. He commonly strangled the blood supply of a portion of the body to stop beeding. Almost all the instruments he designed were stranglers in one form or the other.

Hildanus in 1645 and Heister in 1763 designed instruments similar to guillotine to remove uvula by strangulation.



Diagramatic illustrations of various instrument designed by Pare

Hildanus in 1645 and Heister in 1763 designed instruments similar to guillotine to remove uvula by strangulation.

Figure shows the Instrument designed by Heister to perform uvulectomy. This instrument was later modified to perform tonsillectomy by him.

Image of Tonsillotome designed by Physick

Physick of United States of America modified Heister's design and created tonsillotome. He used this instrument to perform lots of tonsillectomies.

Pierre Desault a French surgeon designed an instrument to break up bladder stones. It was a half moon shaped metallic device that had in its extremity a small knife. This instrument suited tonsillectomy than any of the instruments designed for this purpose before.
The partially successful Physick model tonsillectome underwent further modifications in the hands of Fahnestock of United states and Mackenzie of London. They modified the original tonsillotome and made it suitable for routine use.

Figure showing Mackenzie tonsillectome

Greenfield Sluder of St Louis designed and used the first guillotine cutter for tonsillectomy. He performed hundreds of surgeries and demonstrated the safety of his equipment. Guillotine tonsillectomy was hence known as Sluder tonsillectomy in his honour.

Picture showing Sluder's guillotine used for tonsillectomy. It had three interchangeable blades to suit different sizes of tonsil. Sluder performed the surgery on a sitting patient. He always ryperformed the procedure under local anesthesia. He also claimed 99% success rate using this procedure.
At this juncture it should be pointed out history has been rather cruel to our medical / surgical inadequacies. This has been amply illustrated by the preventable premature death of George Washington of United states. In 1799 when George Washington [5] fell ill following an attack of peritonsillar abscess all that was needed to be done was immediate drainage of the abscess. This was not done due to poor knowledge those days. He died of respiratory distress due to oedema of the upper airway following quinsy.

Initially all tonsillectomies were performed by general surgeons. Towards the end of 19th century it came into the exclusive domain of ENT surgeon. Good illumination, along with the use of excellent mouth opening using tongue depressor helped the cause.
Joseph Beck described a device for removing tonsils. It had a cutting wire inside a rigid ring known as Beck-Mueller´s ring. Usually this ring is passed around the tonsil which is to be removed, and the cutting wire is tightened slowly cutting the tonsil. The major advantage of this instrument is that it also chocked the blood supply to the tonsil there by minimizing bleeding.

The Beck-Mueller´s ring should be considered to be the precursor for the various types of snares that are being used in tonsillectomy these days.

During the 19th century with the advent of better anesthesia techniques and better surgical equipments tonsillectomy became a relatively safe procedure. Cohen added to the safety of the procedure by ligating and tying the bleeding vessels with silk.

Gregg Dhillinger developed a method called diathermy to reduce bleeding following tonsillectomy. He firmly believed that bleeding following Guillotine tonsillectomy procedures were rather high. He used the diathermy to cauterize and coagulate bleeding vessels seen in the tonsillar bed.

George Earnest Waugh of England was the first to use careful dissection method to remove the tonsil [6] . He is also credited with the design of Waugh's tenaculum forceps which he used to dissect tonsil out of its bed (1909). Innovations that took place like the use of diathermy, harmonic scalpel, debrider were meant to reduce the operating time and bleeding during the procedure.

Introduction:

Currently coblation is being attempted to remove tonsillar tissue. This process was invented by Philip E Eggers and Hira V Thapliyal in 1999. Coblation tonsillectomy received FDA approval in 2001 [7].

Advantages of coblation tonsillectomy:

1. Less bleeding
2. Preservation of capsule is possible if done under magnification. If capsule is preserved there is
less post operative pain
3. Tonsillar reduction surgeries can be performed in young children without compromising the
immunological function of the lymphoid tissue

The Procedure:

Coblation technology uses bipolar radiofrequency waves transmitted via isotonic saline solution. This process generates plasma which ablates tissue. Temperature required for ablation is about 60 degree centigrade. Since there is no abnormal heating of tissue during coblation there is very minimal collateral damage to adjoining tissue. Author prefers to use cold normal saline while performing coblation surgeries because the quality of plasma is better with cold saline. Normal saline is refrigerated overnight to make it cold. Evac 70 wand is used to perform tonsillectomy.

Coblation tonsillectomy is ideally performed under microscopy inorder to identify the tonsillar capsule. If the dissection stays extracapsular post operative pain is less. Pain following tonsillectomy is caused due to spasm involving pharyngeal musculature. This is avoided if dissection stays away from the capsule.

Coblation tonsillectomy is performed under general anesthesia. Patient is put in Rose position (the same position that is used for conventional tonsillectomy). Operating microscope is used for visualisation. Lowest magnification is chosen.

Advantages of performing coblation tonsillectomy under magnification:

1. Capsule is easy to identify under magnification and hence can be preserved by performing extracapsular tonsillectomy

2. Microscopic images can be connected to a monitor. Surgeon hence has the option of operating seeing the monitor as they do in endoscopic sinus surgery

3. The entire surgical procedure can be recorded and documented, hence it is useful for teaching and training students of otolaryngology.

Image showing microscope being adjusted before coblation tonsillectomy

While adjusting the microscope it should be ensured that both tonsils appear in the same field as seen during regular tonsillectomy procedure.

At this point it should be borne in mind that there is a learning curve involved in this technology. The following tips would ensure that this curve is surmounted seamlessly.

1. Always start with a clean slate. This facilitates easy learning process.

2. The wand should be held in such a way that it forms an angle of 30 - 40 degrees with the tissue that needs to be ablated because for adequate plasma generation saline should come into contact with the electrodes.

3. While performing tonsillectomy the want should not be in physical contact with the tissue, but should be periliously close to it. This would ensure proper formation of plasma.

4. When confronted with a bleeder, the wand should hover over the bleeder (Tim's Hover technique). Invariably this stops the bleeding. In the event of persistant bleeding then wand should be placed in contact with the bleeder and cautery pedal needs to be pressed. Since this procedure is performed under magnification, even a small bleeder will appear magnified.

5. Abalate pedal should be pressed intermittently for effective and efficient generation of plasma. Studies have shown that the quality of plasma generated is rather poor when ablate mode is continuously used by continuous pressure on the pedal.

6. Use of copious irrigation during the procedure is a must. This ensures continuous generation of plasma.

Picture showing the proper way of holding the wand while performing tonsillectomy on the left side

If excess smoke is generated during coblation surgery then it indicates tissue is caught between the electrodes. The wand should immediatly be declogged using saline irrigation. "Beware of smoky wand".

For a beginner right sided coblation tonsillectomy is easier if the dominant hand is right. For performing left coblation tonsillectomy the wand should ideally be held in the left hand. This may take some doing if the dominant hand is right.

Tonsil is held with tonsil holding forceps and gently pulled medially. wand should be held at an angle of 30 - 40 degrees with the tissue being ablated. This will ensure that saline gets into contact with the bipolar electrode available at the tip of the wand. Incision is made just medial to the anterior pillar. Ablation can start either from lower pole to upper pole or from upper pole to lower pole according to the preference of the surgeon. The process of ablation should be uniform and the wand should stay close to the tonsillar tissue and away from the capsule to prevent damage to it. If ablation is not uniform then the surgeon will end up digging a pit in the tonsillar tissue and also will encounter more bleeding than envisaged.

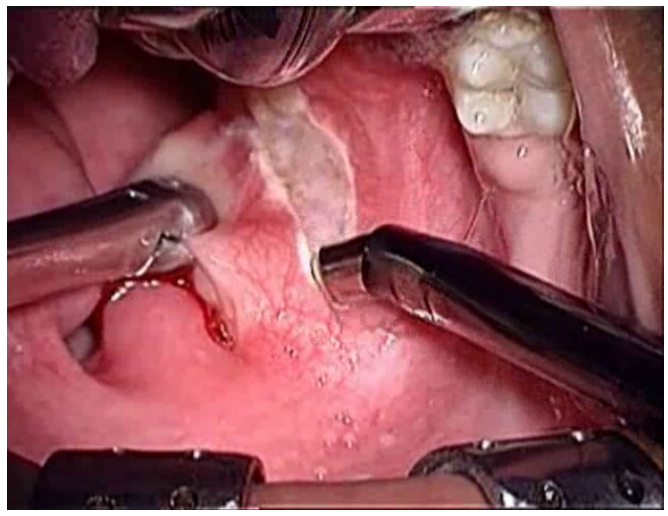


Figure showing the right way of doing coblation tonsillectomy. Incision is seen being given from inferior pole to superior pole of tonsil

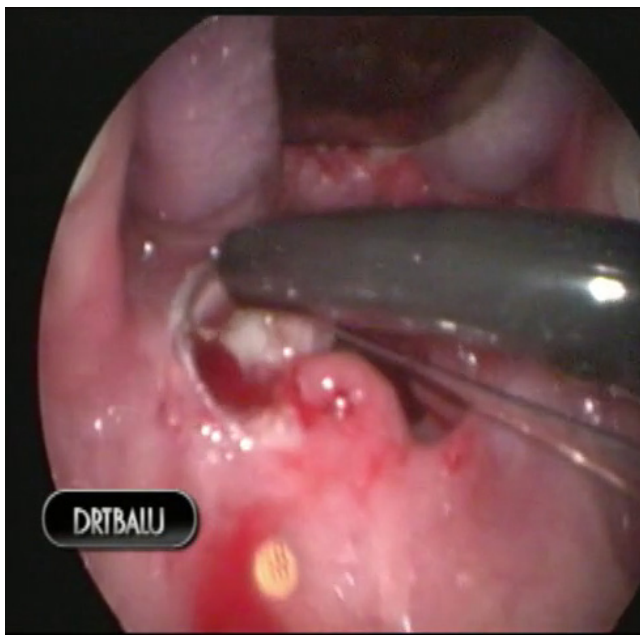


Figure showing the wrong way of ablating tonsillar tissue. Note formation of pit in the tonsillar tissue associated with bleeding

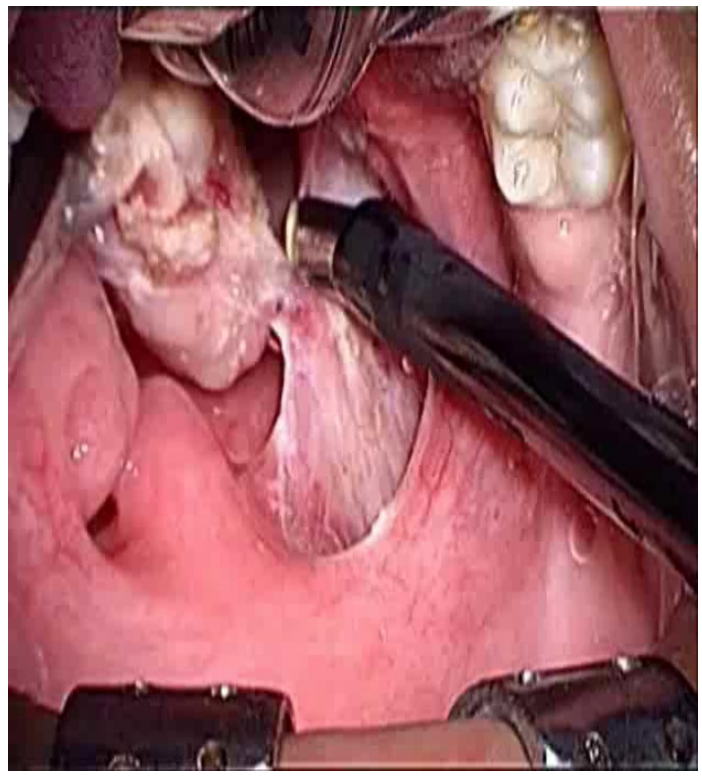


Figure showing coblation tonsillectomy about to be completed

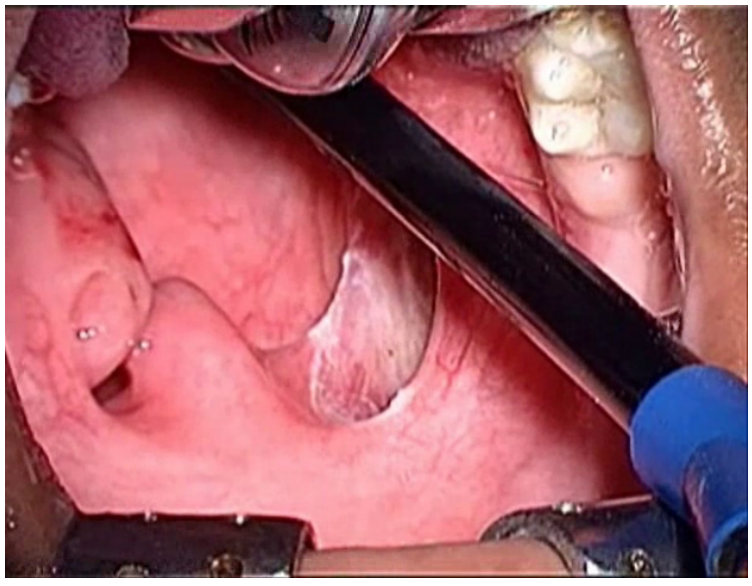


Figure showing tonsillar fossa with intact capsule after removal of tonsil

A little medial traction of tonsil while ablation is being performed will make separation of tonsil from the fossa that much easier. Traction also helps the surgeon to visualize the capsule.

While working close to the superior pole of tonsil injury to uvula and soft palate should be avoided. Injury to these structures during surgery will increase post operative pain thereby negating the advantage of coblation tonsillectomy.

Post operative secondary bleeding is common in coblation tonsillectomy when compared with that of conventional cold steel method. Bleeding is not torrential but blood tinged saliva could be seen in some patients during the second week following surgery. This is due to the formation of granulation tissue, which is part of the healing process.

Debulking of hypertophied tonsils:

Performing tonsillectomy [8] in young children is not a commonly accepted procedures. Debate is still raging on the influence of tonsillectomy on immunity of the child. Debulking is a good trade off, where in the hypertrophied tonsil can be debulked leaving behind a sleeve of residual lymphoid tissue to take care of the child's immunity.

This procedure was first performed using microdebrider. Bleeder's are cauterized using bipolar cautery. Use of coblation has made this surgery easy to perform.

Figure showing Tonsillotomy (Tonsillar debulking surgery) being performed

While performing tonsillotomy the wand should be in contact with the tissue, hence there is always the risk of wand getting clogged with debris and hence need to be declogged by flushing with a syringe. Clogging can be reduced if the flow of saline is increased. Author prefers to over ride the auto mode of the irrigation system to manual and seeking the help of assistant to compress / squeeze the saline bag while performing the surgery.

Suction used during tonsillotomy procedure should be reasonably powerful so that there is no unnecessary accumulation of fluid and debris in the surgical field.

Advantages of Tonsillotomy:

1. Post operative pain is less

2. Child's immunity is not compromised atleast theoretically

Disadvantages of coblation:

1. Cost of wand is high.

2. It can be used only once because secondary infections / secondary bleeding following coblation surgery using already used wand is high.

3. Reuse of wands should be discouraged because plasma generation is not optimal when wands are reused.

References:

1. https://www.scribd.com/doc/27709493/History-of-Tonsillectomy

2. https://en.wikipedia.org/wiki/Heinrich_Wilhelm_Gottfried_von_Waldeyer-Hartz

3. http://www.wdl.org/en/item/11618/

4. http://www.utmb.edu/otoref/grnds/Tonsillectomy-2005-0427/Tonsillectomy-050427.pdf

5. http://www.uptodate.com/contents/peritonsillar-cellulitis-and-abscess

6. Thiagarajan, Balasubramanian. “Coblation Tonsillectomy our experience” Otolaryngology online journal [Online], Volume 4 Number 1.5 (13 March 2014)

7. Temple RH, Timms MS. Paediatric coblation tonsillectomy. Int J Pediatr Otorhinolaryngol 2001;
61(3): 195-8.

8. Child behavior and quality of life before and after tonsillotomy versus tonsillectomy Ericsson, Elisabeth et al. International Journal of Pediatric Otorhinolaryngology , Volume 73 , Issue 9 , 1254 - 1262

Coblation Adenoidectomy

Introduction:

Adenoidectomy is one of the most commonly performed surgeries in children. Complications following adenoidectomy is fortunately rare [1]. Various surgical techniques have been devised to improve the outcome following adenoidectomy, and to reduce bleeding during the procedure. Operating surgeon should lay emphasis on the safety, accuracy and outcome of the procedure before deciding on the surgical technique.

During the past decade there has been an increase in awareness of high prevalance of sleep disorderred breathing in children. Majority of these disorders have been attributed to adenoid hypertrphy. Large number of these patients undergo adenoidectomy alone or a combination of adenoidectomy and tonsillectomy.

Various methods of performing adenoidectomy include:

1. Conventional cold steel technique using adenoid currette

2. Bipolar coagulation under endoscopic vision

3. Adenoidectomy using microdebrider

4. Coblation adenoidectomy [2]

Adenoid hypertrophy has a tendency to recur after surgery. The recurrence rate has been found to be highly variable between studies. Lundgren's series put the recurrence rate between 4-8%, while Hill's series showed a variation between 23.7-50%.

Tolczynski (1955) [3] attributed the variations in recurrence rates between different studies to the following factors:

1. Anatomical difficulties

2. Adenoid area is difficult to visualize

3. Adenoidectomy is often performed in a hurry, sometimes under inadequate anesthesia. This causes inadequate relaxation of palato-pharyngeus muscles interfering with surgical manipulation of adenoid pad of tissue.

Adequate removal of hypertrophied adenoid tissue is difficult using conventional currettage in the following scenario:

1. When there is intranasal extension of adenoid tissue.

2. Bulky mass of adenoid tissue superiorly in the nasopharynx

3. Adenoid tissue in the peritubal region

In the light of above stated facts, to ensure complete or near complete removal of adenoid tissue, direct / indirect visual assistance is mandatory [4].

Recent study by Ezaat 2010 [5] demonstrated that when routine endoscopic examination of nasopharynx was performed after conventional adenoidectomy about 14.5% of patients demonstrated residual adenoid tissue which was needed to be removed. He thus went on to conclude that routine endoscopic examination of nasopharynx following adenoidectomy clearly reduced the incidence of revision adenoidectomy at a later date.

Coblation adenoidectomy is currently becoming popular because:

1. It facilitates complete removal of adenoid tissue under direct vision

2. Bleeding is very minimal

3. Every area of the nasopharynx is accessible to the wand tip

4. Lower incidence of left over residual adenoid tissue

5. Lower risk of complications

Coblation adenoidectomy can be performed under direct vision by using an endoscope through the nasal cavity / endoscope (angled) via throat after retracting the soft palate.

The Procedure:

Coblation adenoidectomy is performed under general anesthesia. Author prefers to perform tonsillectomy before adenoidectomy if coblation technique is used because the same wand used for tonsillectomy can be bent to perform adenoidectomy thereby cutting down on wand cost. Evac 70 is preferred by the author for adenoidectomy. If difficulties are encountered in reaching the roof of nasopharynx the wand can be bent appropriately. Wand can be bent at the junction of anterior and middle thirds.

After completion of tonsillectomy under Rose position, the tonsillar jack is removed. Sand bag under the shoulder is also removed. Patient's head is elevated to 30 degrees. (Head up position as in nasal surgeries). If the nasal cavity is roomy enough the wand can be inserted along with the nasal endoscope through the nasal cavity and the surgery is performed. In the event of a narrow nasal cavity the wand can be inserted through the mouth after retracting the soft palate using soft rubber catheter passing through the nasal cavity. Nasopharynx can be visualised using a nasal endoscope passed through the nasal cavity or by passing an angled endoscope through the oral cavity under the soft palate.

Wand can be used to ablate adenoid tissue. Adenoid tissue is ablated till muscles of the posterior wall of nasopharynx is exposed. The movement of the wand while performing adenoid tissue ablation resembles that of removing cobweb in the roof of a room. Irrigation should be copious while ablating adenoid tissue as there is a risk of wand getting clogged with ablated tissue. The risk of wand clogging is higher during adenoid ablation because the wand is in direct contact with the tissue. One major draw back of this position is the risk of aspiration. Consious effort should be made on the part of the surgeon to keep applying suction periodically to prevent aspiration.

Currently coblation adenoidectomy is being performed in the Rose position itself. After completion of tonsillectomy, the soft palate is retracted by passing thin nasal suction catheters through both the nasal cavities and delivering it through the mouth. Soft palate can be retracted by tying these catheter ends.

Figure showing soft palate being retracted using a pair of nasal suction catheters

After retraction of soft palate an angled telescope (30 degree 4 mm) can be used through the oral cavity to visualize the nasopharynx. Evac 70 wand can then be passed through the oral cavity to reach up to the nasopharynx for ablating adenoid tissue. Advantage of this procedure is that there is absolutely no risk of aspiration. Added advantage being that the patient's position need not be changed midway through the procedure. The surgeon's position too resembles conventional adenoidectomy. Copious irrigation of saline ensures adequate plasma generation for tissue ablation.

Currently Procise Max wand has been promoted as a better tool for coblation adenoidectomy by the manufacturer.

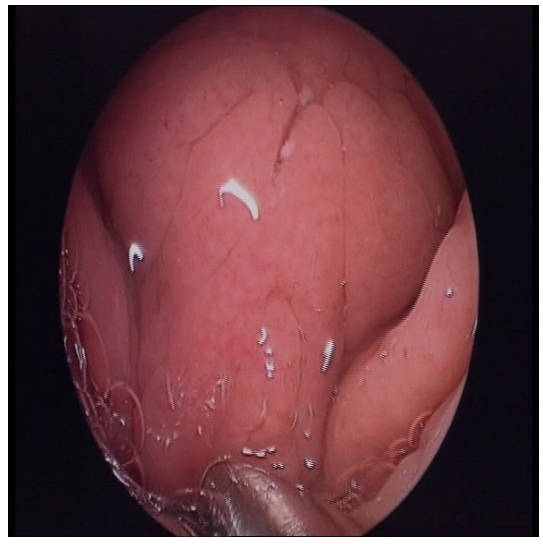
Advantages of Procise Max wand according to manufacturer are:

1. Tissue ablation is rapid because of the unique flat screen electrode

2. Suction port in this wand is also very effective.

According to the manuflacturer ablation rate of procise wand is about 50% faster than that of conventional Evac 70 wands.

Figure showing the tip of Procise Max electrode with its flat screen electrode



Adenoid tissue being visualised using an endoscope through the oral cavity

The procedure should be started with a straight wand. To access difficult to reach areas the wand can be bent for better access.

Figure showing how to bend the wand

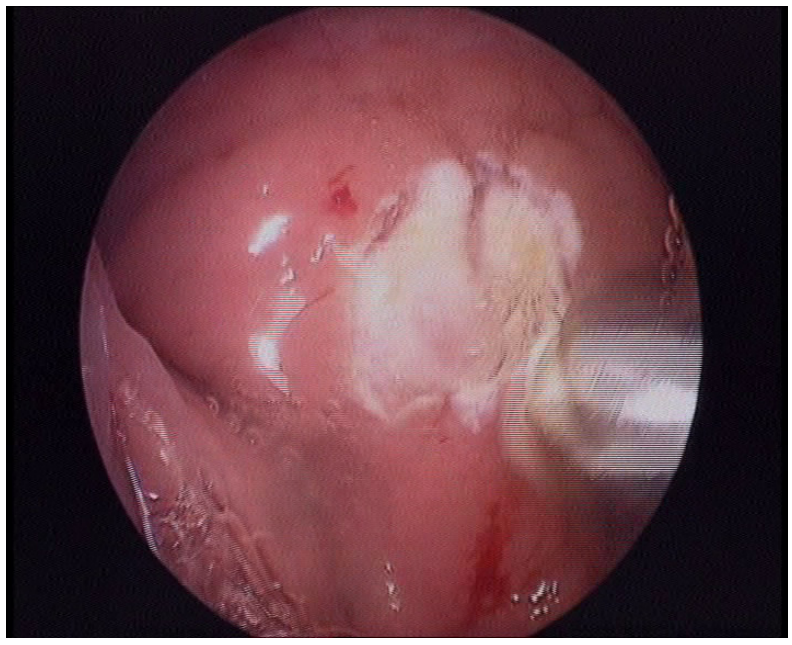


Figure showing adenoidectomy begun

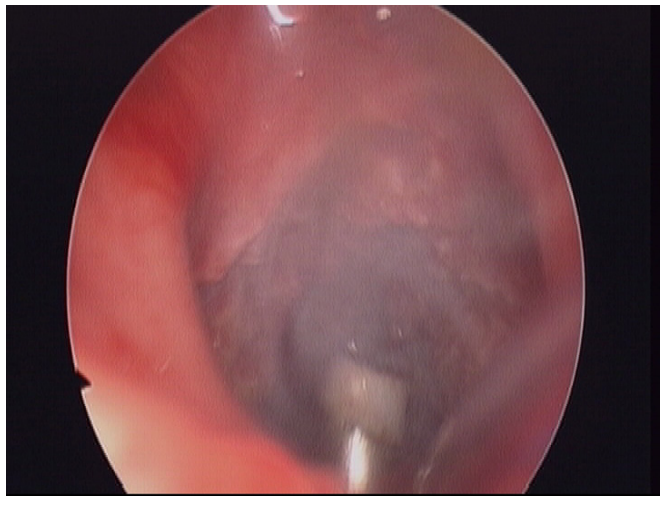


Figure showing fumes arising from a clogged wand

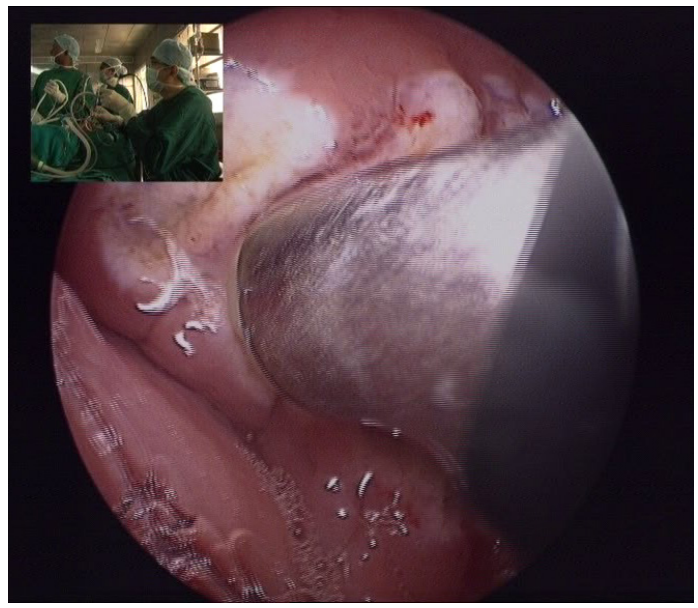
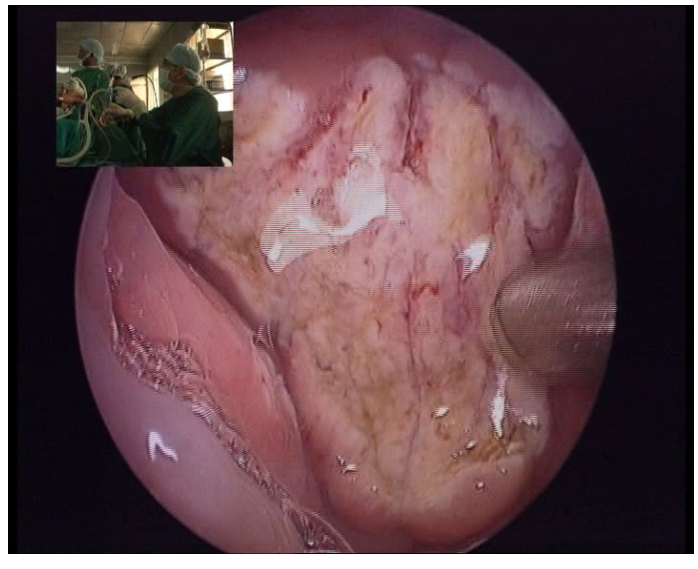


Figure showing Tubal tonsil being ablated. Inset showing surgeon seated at the head end of the patient



Close up view of adenoid tissue being ablated. Inset shows surgeon seated at the head end of the patient

During surgery saline irrigation should be profuse. Recommended suction pressure should be between 250-350 mm Hg.

Coblation adenoidectomy is getting popular because hither to blind procedure is now being performed under direct vision. In coblation adenoidectomy tubal tonsil and adenoid tissue around torus tubaris can be ablated with reasonable confidence without fear of injury to eustachean tube because it is being done under direct vision.

For purposes of classification and management adenoid hypertrophy has been graded according to the size of the tissue and its relationship with vomer, softpalate and torus tubaris [6].

Grade	Anatomical structure in contact with adenoid tissue
Grade I	None
Grade II	Torus tubaris
Grade III	Torus tubaris, Vomer
Grade IV	Torus tubaris, Vomer and soft palate at rest

Figure showing grade of adenoid hypertrophy

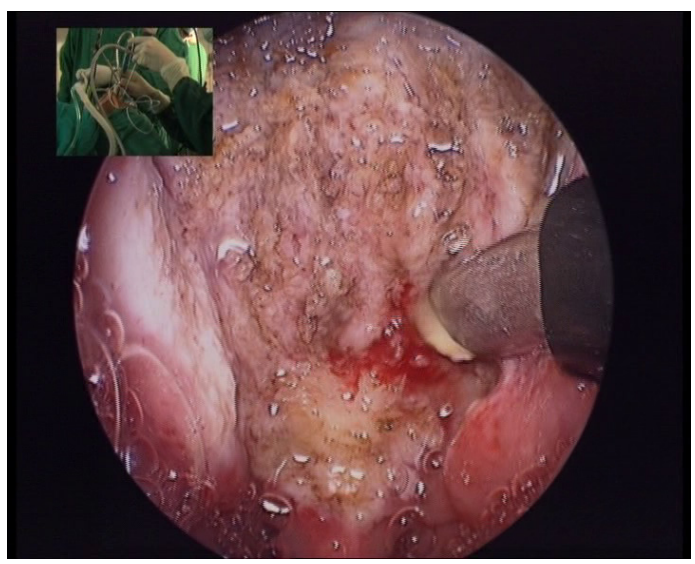


Figure showing adenoid bleed being cauterized

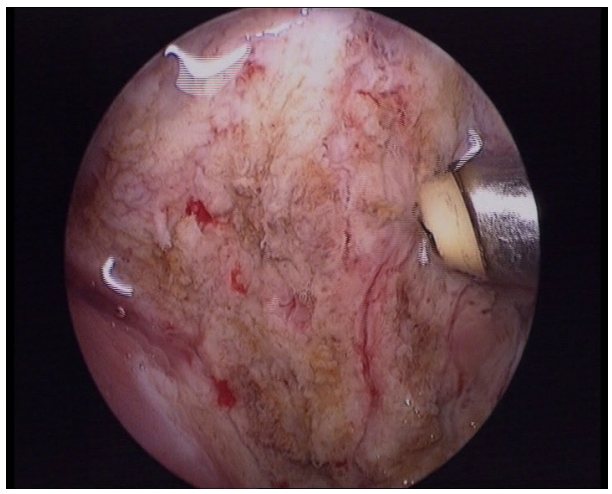


Figure showing prevertebral fascia being exposed after ablation of adenoid tissue. Note copious saline irrigation

Process of ablation should stop as soon as preverterbral fascia is reached. It can be identified by its white color. Care must be taken not to damage underlying prevertebral muscles. If bleeding is encountered it should be immediatly cauterized by using coagulation mode.

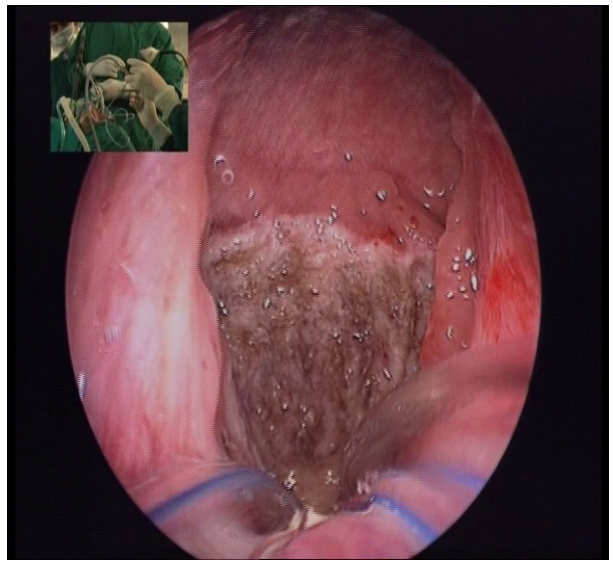


Figure showing complete adenoid removal

Disadvantges of coblation adenoidectomy:

1. Cost involved is high

2. Operating time is more when compared to conventional adenoidectomy

3. Author encountered significant secondary bleeding following coblation adenoidectomy in one patient. Post nasal pack and hospitalization was needed before the patient recovered.

Conclusion:

Even though current cochrane review does not find any significant advantage for coblation adenoidectomy over conventional adenoidectomy procedures, further scientific evaluation is needed before last word is out about this procedure.

References:

1. Gallagher TQ, Wilcox L, McGuire E, et al. Analyzing factors associated with major complications after adenotonsillectomy in 4776 patients: comparing three tonsillectomy techniques. Otolaryngol Head Neck Surg 2010;142:886-92.

2. Thiagarjan, Balasubramanian, AND Nair, Vrinda. “Coblation adenoidectomy our experience” Otolaryngology online journal

[Online], Volume 4 Number 1.5 (14 March 2014)

3. Tolczynski, B. (1955). The recurrence of adenoids. Canadian Medical Association Journal,
Vol.72, No.9, pp. 672-673.

4. Ark, N; Kurtaran, H; Ugur, KS; Yilmaz, T; Ozboduroglu, AA & Mutlu, C. (2010).
Comparison of adenoidectomy methods: examining with digital palpation vs.
visualizing the placement of the curette. International Journal of Pediatric
Otorhinolaryngology, Vol.74, No.6, pp. 649-651.

5. Ezzat, WF. (2010). Role of endoscopic nasal examination in reduction of nasopharyngeal
adenoid recurrence rates. International Journal of Pediatric Otorhinolaryngology,
Vol.74, No.4, pp. 404–406.

6. Validation of a new grading system for endoscopic examination of adenoid hypertrophy
Sanjay R. Parikh, MD, Mark Coronel, MD, James J. Lee, MD, and Seth M. Brown, MD,
New York, New York Otolaryngology–Head and Neck Surgery (2006) 135, 684-687

Coblation Kashima Procedure (posterior cordotomy)

Introduction:

Bilateral vocal fold paralysis is a surgical emergency, which should be addressed immediatly. Securing the airway takes precedence over quality of voice. Two terms need to be explained at this stage: BVFI (Bilateral vocal fold immobility) and BVFP (Bilateral vocal fold paralysis) [1].

Bilateral vocal fold immobility: This is actually a broad term encompassing all forms of reduced or absent vocal fold mobility. Immobility could be due to mechanical fixation or neurological involvement.

Bilateral vocal fold paralysis: This condition refers to neurological causes of vocal fold immobility / reduced mobility. This specifically refers to absent function of vagus nerve or its distal branch the Recurrent laryngeal nerve.

Bilateral vocal fold immobility is a potentially fatal disorder which needs to be diagnosed early and treated appropriately [2].

Causes of bilateral vocal fold immobility include:

1. Bilateral recurrent laryngeal nerve palsy

2. Bilateral fixation of cricoarytenoid joint

3. Laryngeal synechiae

4. Posterior glottic stenosis

5. Post intubation trauma

6. Inflammatory disorders

It is important to differentiate these conditions. Kashima surgery is indicated only in patients with bilateral vocal fold paralysis. These conditions can be differentiated by:

Taking detailed clinical history

Video laryngoscopic examination

Laryngeal electromyography

Palpating arytenoids under anesthesia (microlaryngeal examination)
In the author's series thyroidectomy constituted the most important cause for bilateral vocal fold paralysis.

Aim of treatment:

1. To secure the airway

2. To preserve glottic sphincter mechanism

3. To maintain voice quality [3]. These patients invariably have good voice.

Existing surgical options:

These include:

1. Tracheostomy

2. Total arytenoidectomy

3. Subtotal arytenoidectomy

4. Transverse cordectomy

5. Vocal fold lateralization

6. Reinnervation techniques

7. Kashima procedure

Among these procedures tracheostomy should be the initial life saving one. In case a patient is presenting with stridor then air way should be secured at the earliest by performing tracheostomy.

Image showing a patient with tracheostomy

Clinical features:

Management of bilateral abductor paralysis depends on the clinical presentation. This include:

1. Stridor due to airway compromise

2. Near normal voice

Degree of stridor may vary depending on [4]:

1. Amount of glottic chink

2. Arytenoid body mass

3. Presence / absence of comorbidity

4. Physical activity

10% of these patients need no intervention. Some of these patients could become decompensated and develop stridor after physical activity or a bout of respiratory infection.

Causes of Bilateral abductor paralysis presented at our institution:

1. Surgical - commonly following total thyroidectomy - 59%

2. Post intubation sequele 25%

3. Trauma - 2%

4. Neurological disorders - 15%

5. Extralaryngeal malignancies 5-17%

For centuries tracheostomy was the treatment of choice for these patients. Even now all the existing procedures are compared with that of tracheostomy. Tracheostomy hence still remains the gold standard against which all other treatment modalities for bilateral abductor paralysis is compared. In 1922 Chevalier Jackson [5] introduced the procedure ventriculocordectomy as a treatment procedure for bilateral abductor paralysis. Major advantage of this procedure is that it created an excellent airway, but the voice became a bit breathy because of excessive air leak while speaking. In 1939 King [6] proposed extralaryngeal arytenoidectomy.

In 1976 D.L. Zealer and HH Dedo [7] attempted to restore natural function of the vocal fold by electrical stimulation of cricothyroid muscle with varying degrees of success.

In 1979 Fernando R. Kirchner described a series of patients who underwent lateralization of vocal fold as a treatment modality for bilateral abductor paralysis.

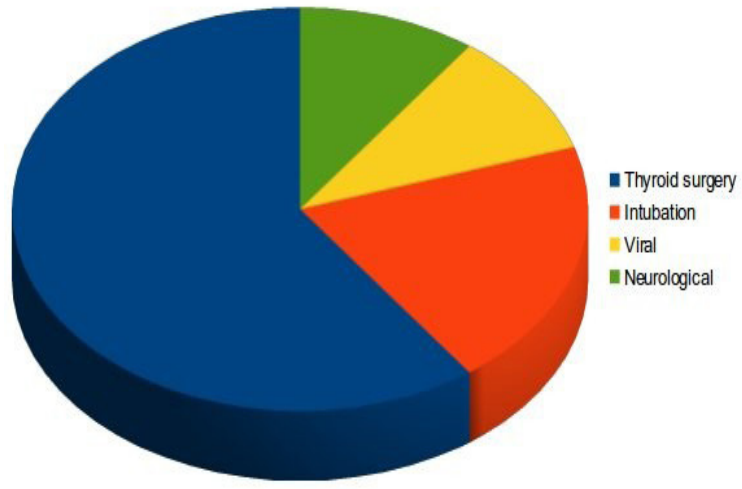


Figure showing the various causes of bilateral abductor paralysis which presented at the Out patient department of Stanley Medical College

Kashima's Posterior cordotomy:

Surgical procedure introduced by Dennis Kashima in 1989 revolutionized the management of patients with bilateral abductor paralysis. This technique involves resection of soft tissues and transection of conus elasticus. A C shaped wedge of posterior vocal fold is excised begining from the free border and extending to about 4 mm laterally. Rationale in this procedure is release of tension of the glottic sphincter rather than actual removal of glottic tissue. If the created airway is not adequate then the same procedure may also be repeated on the opposite side also.

Reker and Rudert modified Kashima's procedure by a complementary resection in the body of lateral thyroarytenoid muscle anteriorly from the initial triangular incision. This procedure enabled creation of better airway without compromising voice quality.

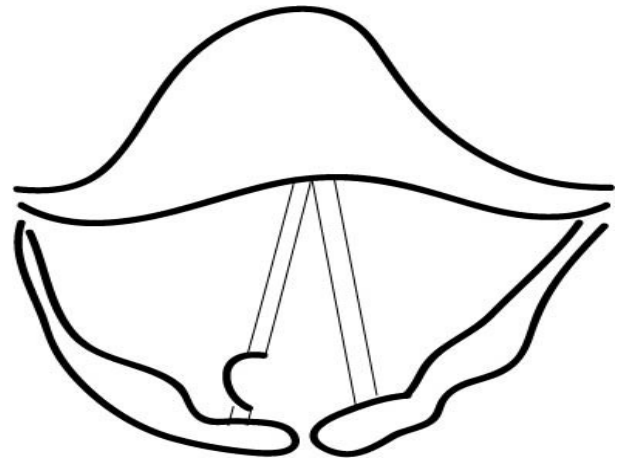


Diagram showing the site of resection in kashima's procedure

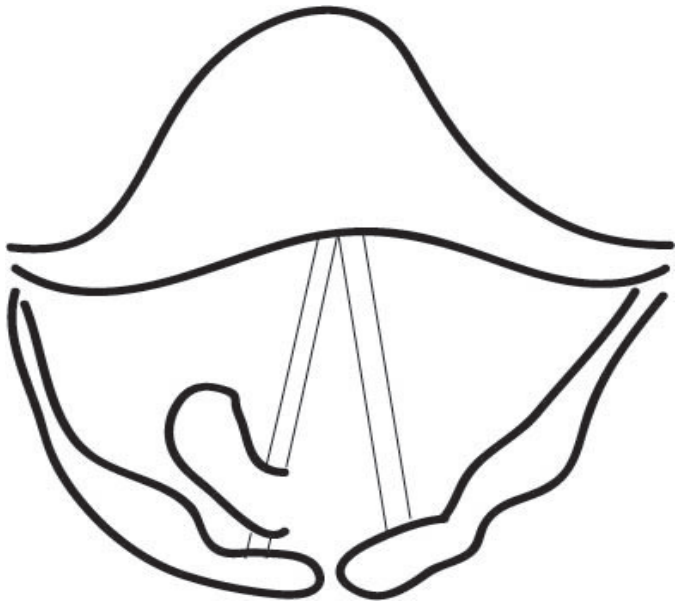


Diagram showing Recker's modification of Kashima's procedure

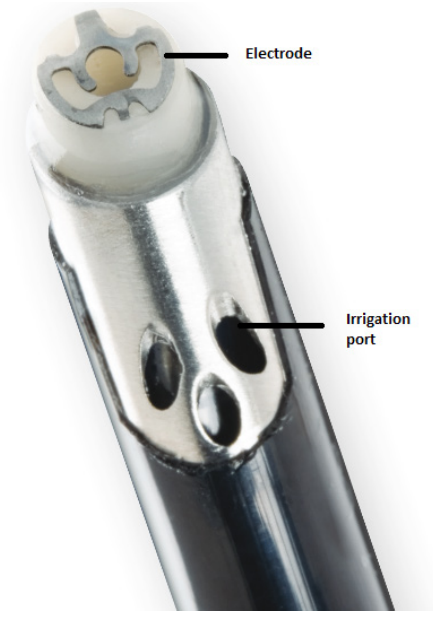


Figure showing laryngeal wand tip

Surgical Procedure:

This surgery is ideally done under general anesthesia. Klein sassaur suspension laryngoscope is used to keep the mouth open during surgery [8]. A modification of Klein sassaur laryngoscope which has a port for insertion of 12 degree telescope is used. Camera can be attached to the telescope and the surgery can be proceeded with by visualizing the vocal cord in the monitor.

Advantages of this modified Klein Sassaur suspension laryngoscope are:

1. Image quality is excellent

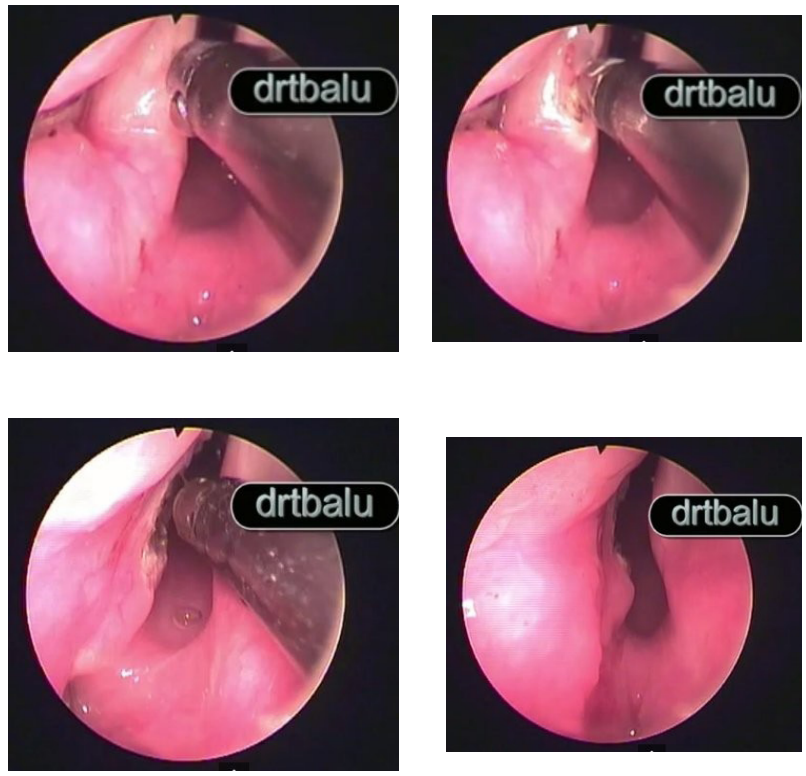
2. Can be recorded

3. Can be used to teaching purposes

4. Both hands are free

Laryngeal wand is used for this procedure. This wand is ideal because its curvature suits manipulation of the wand close to the vocal cords. Malleability of this wand ensures that it can be bent to facilitate better access. Major advantage of coblation technology over laser / diathermy is that there is absolutely no risk of airway fire.

When laryngeal wand is connected to the controller the default settings get highlighted. Ablate - 7 Coag - 3. Suction should ideally be set to approximately 250 mm of Hg. Saline flow should be set to a minimal intermittent drip just enough to produce plasma. Too much of saline irrigation can cause aspiration.



Figures showing various stages of Kashima's procedure

Ventricular band should be spared during the surgery. Damage of ventricular bands could cause unacceptable voice changes in a patient who undergoes this treatment.

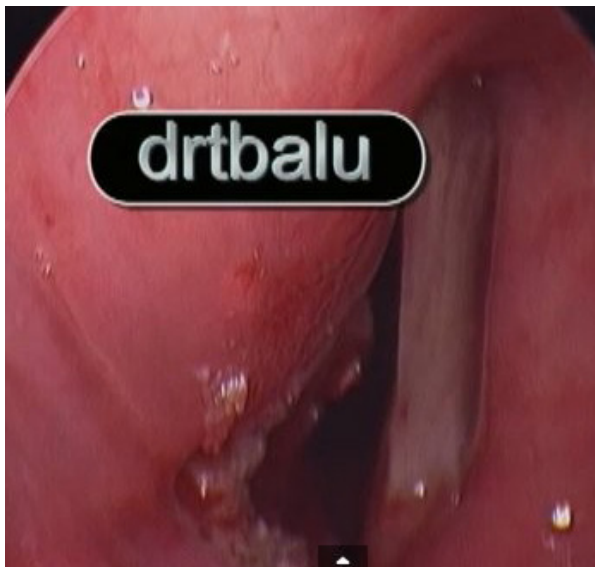


Image showing Recker's modification of Dennis Kashima procedure

This enlarged posterior glottic space helps in improving the airway without compromising voice quality. Since the anterior 2/3 of the vocal fold is preserved, voice quality is usually good in these patients.

Early decannulation:

All these patients should be decannulated at the earliest. It is preferable to spiggot the tracheostomy tube on the first post operative day itself. This would facilitate natural airflow through the glottis causing wound to heal better and faster. This is infact one of the most important advantages of this procedure.

Author has performed 30 cases of coblation Kashima procedure. All of them were successfully decannulated and weaned off the tracheostomy tube. Three year follow up of these patients showed no evidence of airway compromise.

Which cord to operate?

Bilateral abductor paralysis is a bilateral condition. Either of the two cords may be subjected to posterior cordotomy. Author believes the following criteria could be used to decide which cord to operate on.

1. More medially placed cord is chosen for surgery

2. If both cords are in identical positions then the cord which shows at least a trace of mobility (during video stroboscopic examination) is preferred.

3. If both cords show identical positions and mobility then the surgeon should choose the cord that provides the best access.

Post operatively all these patients should receive antireflux treatment for a minimum period of 6-8 weeks.

Complications of Posterior cordotomy:

1. Post operative oedema

2. Granuloma formation

3. Scar formation

4. Posterior glottic web formation

Conclusion:

Posterior cordotomy (Dennis Kashima procedure) using coblation techonology is really promising therapy for patients with bilateral abductor paralysis. This procedure restores sufficient glottic space without causing damage to phonatory and sphincteric functions of larynx.

Advantages of this procedure include:

1. Bloodless ablation

2. Precise ablation of tissue

3. No collateral damage to adjacent tissue

4. No oedema to tissues around larynx

5. Early decannulation is possible

References:

1. 1.Joel A Ernster, MD; Arlen D Meyers, MD. Bilateral Vocal Fold Paralysis. emedicine.medscape.com/article/863885-overview Jan 6, 2012.
2. Krishna P, Rosen CA. Office-based arytenoid palpation for diagnosis of disorders of bilateral vocal fold immobility. Ear Nose Throat J. 2006;85(8):520-2.

3. Motta S, Moscillo L, Imperiali M, Motta G. CO2 laser treatment of bilateral vocal cord paralysis in adduction. ORL J Otorhinolaryngol Relat Spec. 2003;65(6):359-65.

4. Thiagarajan, Balasubramanian, AND Nair, Vrinda. "Kashima's Posterior cordectomy using coablator our experience" Otolaryngology online journal [Online], Volume 4 Number 1.5 (13 March 2014)

5. Jackson C (1922) Ventriculocordectomy. A new operation for the cure of goitrous glottic stenosis. Arch Surg 4: 257–274

6. King BT (1939) A new and function restoring operation for bilateral abductor cord paralysis. JAMA 112: 814–823

7. Zealer DL, Dedo HH (1977) Control of paralysed axial muscles by electrical stimulation. Acta Otolaryngol (Stockh) 83:514–527

Endoscopic Cordectomy

Introduction:

Cordectomy involves removal of entire membranous portion of vocal fold along with vocalis muscle [1]. If needed arytenoid cartilage also can be removed. Inner perichondrium of thyroid cartilage also can be removed if involved by tumor. Cordectomy via laryngofissure approach was the commonly performed surgical procedure for glottic carcinoma in olden days. Even now cordectomy remains the standard by which all other surgical treatments of glottic cancers are measured.

Cordectomy can be performed by:

1. Via laryngofissure

2. Endoscopic cordectomy

History of cordectomy:

In 1908, Citelli first performed cordectomy externa through thyrofissure [2]. In 1922 Chevalier Jackson [3] described total cordectomy for a patient with bilateral abductor paralysis. Major drawback of the procedure described by Chevalier Jackson was the poor quality of voice. Hoover modified the procedure described by Chevalier Jackson by approaching the vocal cords via laryngofissure. Dissection was submucosal. Major advantage of this procedure is the availability of adequate mucosa for primary closure of the surgical wound.

Indications of vocal fold cordectomy:

1. Vocal fold dysplasia

2. T1 malignant lesions of vocal fold

3. Bilateral abductor paralysis

Cordectomy is contraindicated in patients with:

1. Impairment of vocal fold immobility

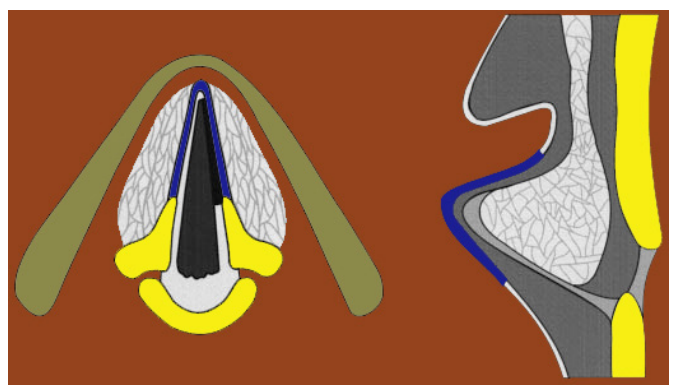
2. Involvement of thyroid cartilage by the tumor

3. When tumor involves either supraglottis / subglottis

European laryngological society in the year 2000 [4] came out with a comprehensive classification of endoscopic cordectomy. 8 types of cordectomies were described by them.

Type I cordectomy (Subepithelial cordectomy):

This procedure involves resection of vocal fold epithelium, passing through the superficial layer of lamina papyracea. This procedure spares deeper layers and thus the vocal ligament. This type of cordectomy is performed in patients with vocal fold premalignant lesions or carcinoma in situ. Since the entire epithelial covering of vocal fold is removed, the specimen can be studied in detail by histopathologist to rule out malignant transformation. In addition to its inherent curative value, this procedure also serves as a good diagnostic source of tissue.



Diagramatic representation of Type I (subepithelial cordectomy)

Type II cordectomy (subligamental cordectomy):

This procedure involves resection of vocal fold epithelium, Reinke's space and vocal ligament. This procedure is performed by cutting between vocal ligament and vocalis muscle. Vocalis muscle is preserved as much as possible. Extent of resection extends from vocal process to the anterior commissure.

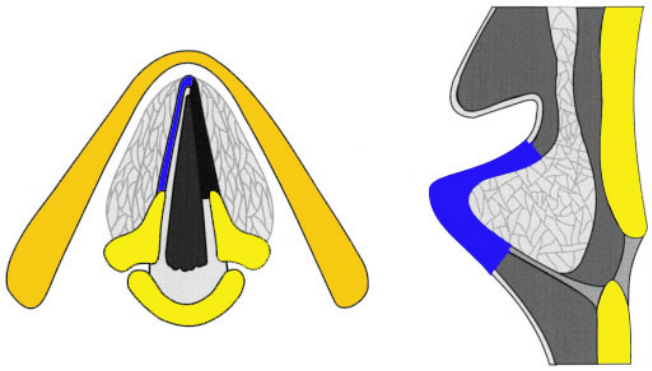
Indications for type II cordectomy:

1. In patients with severe vocal fold leukoplakia

2. When a vocal fold lesion clinically shows sign of neoplastic transformation

3. Vibratory silence as seen during stroboscopic examination

4. Lesion feels thick on palpation. Inability of mucosa to move freely over underlying vocal fold structures



Diagramatic representation of Type II cordectomy (Subligamental cordectomy)

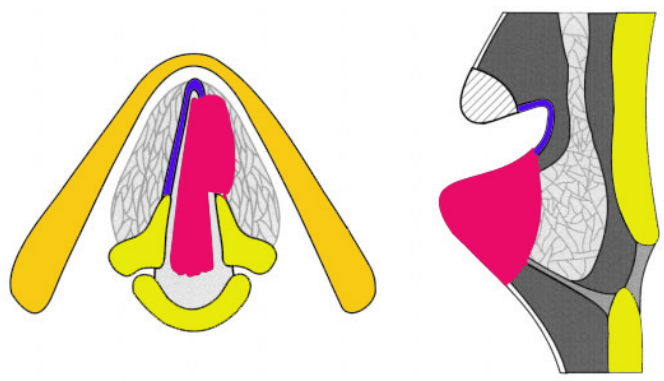


Illustration of Type III cordectomy

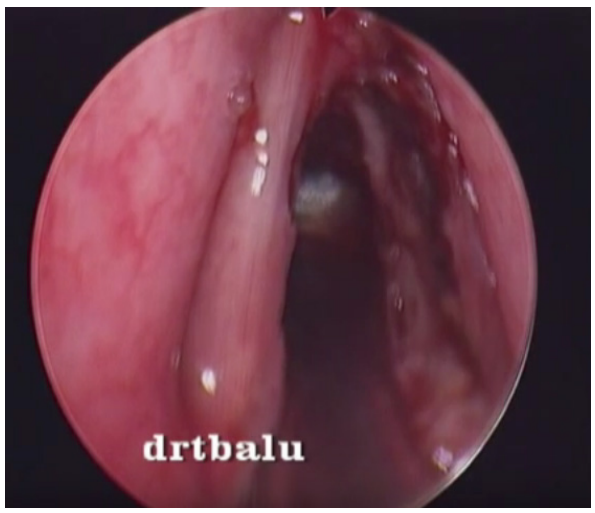


Image showing Type II cordectomy

In some patients for adequate exposure of the entire vocal folds, partial resection of vestibular folds may be needed. Resection of vestibular fold is known as vestibulectomy. This procedure was popularized by Swarc and Kashima [5].

Vestibulectomy is actually defined as subtotal resection of vestibular fold Indications of vestibulectomy include:

1. Removal of lesions confined to vestibular folds

2. To improve visualization and access to vocal cords. The entire cord completely becomes visible after vestibulotomy.

Only risk in this procedure is bleeding from the superior laryngeal artery. This brisk bleeding usually stops with 5 mins of tamponading with cotton / gauze. Use of coblator has reduced the risk of bleeding in these patients. Adequate amount of vestibular fold can be removed thereby exposing the entire superior surface of the vocal cord.

Type III cordectomy (Transmuscular cordectomy):

This procedure is performed by cutting through the vocalis muscle. Resection involves epithelium, lamina propria and portions of vocalis muscle. Resection may actually extend from the vocal process to anterior commissure.

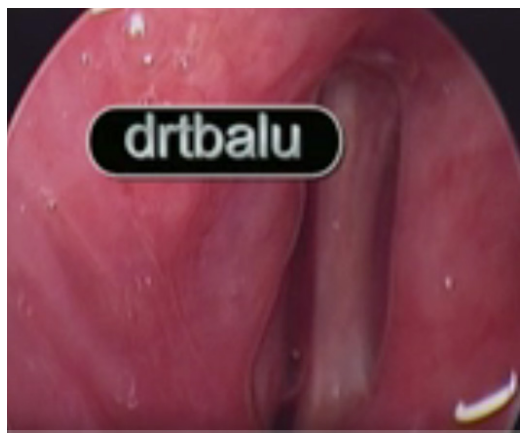
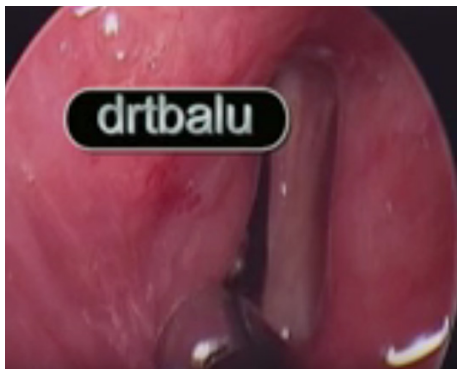
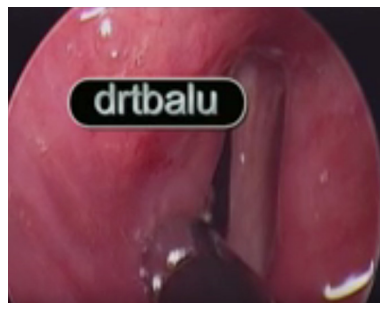


Figure showing hypertrophied vestibular fold obscuring right vocal cord





Figures showing vestibulotomy using coblator laryngeal wand

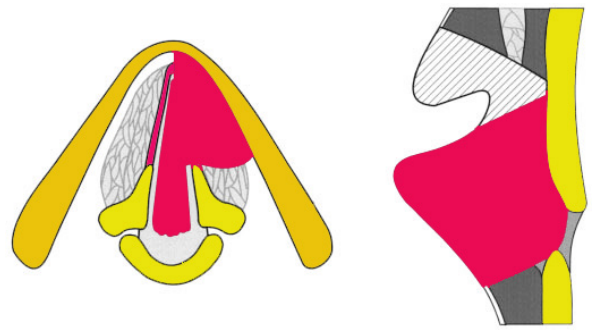


Illustration showing complete cordectomy. Type IV cordectomy. Note ventricular band can be removed to facilitate better exposure of the vocal folds.

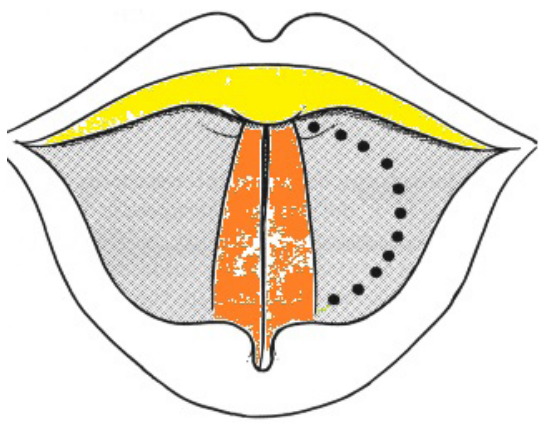


Illustration showing the extent to which ventricular band can be removed

Transmuscular cordectomy is indicated for all cases of small superficial cancers with mobile vocal cords.

Total (Complete cordectomy) Type IV:

Resection in complete cordectomy extends from vocal process of arytenoid cartilage to anterior commissure tendon. The depth of resection can reach up to the inner perichondrium of thyroid ala. If needed the perichondium can also be included in the resection. Anteriorly the incision is made in the anterior commissure. Attachment of vocal ligament to the thyroid cartilage is cut completely. Total cordectomy can be extended to include the ipsilateral ventricular fold.

Extended cordectomy encompassing the contralateral vocal fold (Cordectomy Type Va)

In this type of cordectomy complete resection of involved vocal cord along with a segment / entire portion of the opposite cord is also performed. Anterior commissure tendon is included in the resection. The petiole of epiglottis needs to be resected for complete visualization of the cords. Resection of the contralateral ventricular band can also be resorted to for better visualization. T1b tumor of vocal folds involving anterior commissure can be managed by this procedure. Basic advantage of using coblator in this setting is that the resection can be performed without risk of bleeding. Since there is very little collateral damage to adjacent tissues there is no post op laryngeal oedema. Another very important advantage being there is absolutely zero risk of airway fire during surgery.

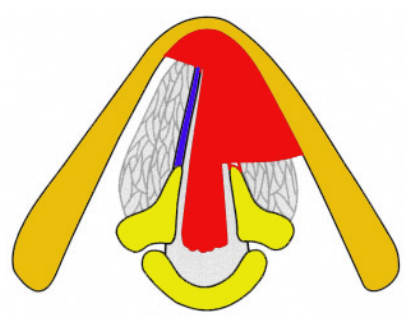


Illustration showing Type Va cordectomy

Extended cordectomy encompassing arytenoid cartilage (Type Vb cordectomy):
This procedure is indicated in patients with vocal fold carcinoma involving vocal process of arytenoid posteriorly. It spares rest of the arytenoid cartilage. The arytenoid is mobile in these patients. Arytenoid cartilage is totally / partially resected along with vocal process. Posterior arytenoid mucosa is preserved. Even if the vocal fold is fixed, this procedure can be attempted if the arytenoid cartilage is mobile.

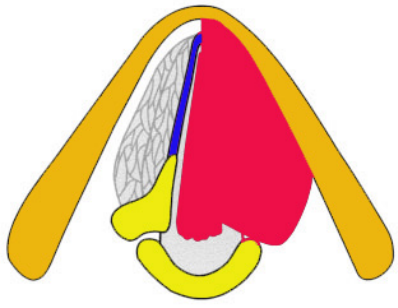


Illustration showing type Vb cordectomy encompassing the arytenoid cartilage

Extended cordectomy encompassing ventricular fold Type Vc cordectomy:

Total cordectomy can be extended to include ventricular fold. This is acutally Type Vc cordectomy. This procedure is indicated in patients with ventricular cancers or for transglottic cancers that spread from the vocal folds to the ventricle. The specimen hence encompasses ventricular fold along with sinus of Morgagni. Inferior margin of resection in this type of cordectomy happens to be the lower border of vocal fold.

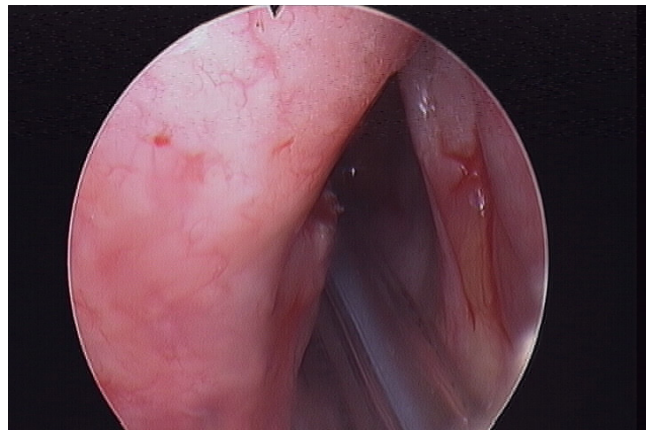


Figure showing Type I cordectomy

Extended cordectomy encompassing subglottis Type Vd cordectomy:

If needed the cord resection can be continued to include subglottis also.About 1 cm under the glottis can be included in resection. This is usually done in order to expose the cricoid cartilage. T2 carcinoma of vocal folds can be managed by this type of cordectomy. According to certain surgeons this procedure does not create adequate tumor margins.

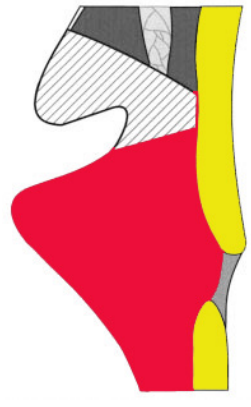


Illustration showing type Vd cordectomy

Classification of cordectomy in to different types helps in:

1. Deciding the efficay of various types of cordectomy in managing vocal fold malignancies

2. To compare the results of various types of cordectomies

3. Helps in training surgeons to reproduce results. Success always lie in reproducing the original success story.

Aims of Endocopic cordectomy:

1. Eradication of malignant process

2. Functional preservation

3. To stage the lesion

Advantages of coblation endoscopic cordectomy include:

1. Easy and simple to perform

2. Less expensive

3. Preserves voice and other protective functions of larynx

Procedure:

This procedure is performed under general anesthesia. Orotracheal intubation using microlaryngeal endotracheal tube is preferred. Advantage of microlaryngeal endotracheal tube is that it snugly fits into the posterior glottis making the anterior glottis better visible. The cuff when inflated expands in a horizontal manner gently spreading the posterior glottic space.

Author prefers to use Kleinsasser suspension laryngoscope with a portal for 12 degree endoscope. Laryngoscope is passed through the oral cavity of the patient. The patient's head should be extended before introducing the laryngoscope. Using endotracheal tube as a guide laryngoscope is advanced towards the glottis. It is ideal to insert the laryngoscope with the 12 degree endoscope inside the port illuminating the passage. Halogen / xenon cold light source is preferred source of light. The laryngoscope is introduced till the petiole of epiglottis is reached. Both vocal folds are clearly visible when the scope rests at the level of petiole of epiglottis.

If the scope is passed deep into the larynx, both vocal and vestibular folds are displaced laterally imparing visibility of free margins of vocal folds. If the scope does not reach the level of petiole of epiglottis the ventricular band obscures the visibility of vocal folds. Once the laryngoscope is in the correct position chest piece is used to stabilize it in position. Ideally positioned laryngoscope should reveal both vocal cords completely from anterior commissure to the vocal process.

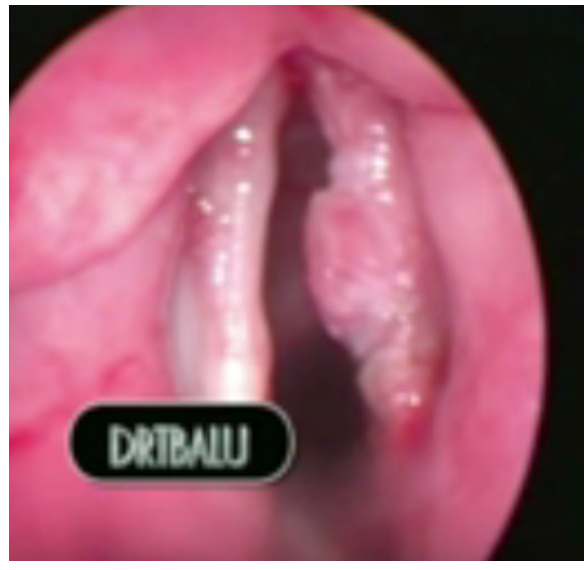


Figure showing the effect of correct positioning of suspension laryngoscope

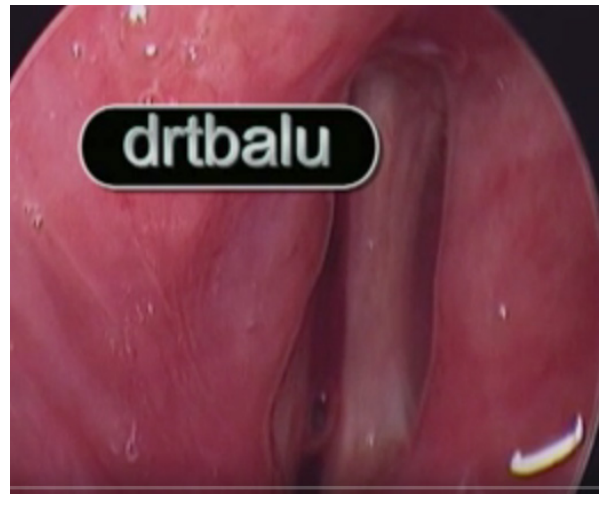


Figure showing the effect if laryngoscope does not reach up to the level of petiole of epiglottis. Note the prolapsing ventricular band obscuring the right vocal cord

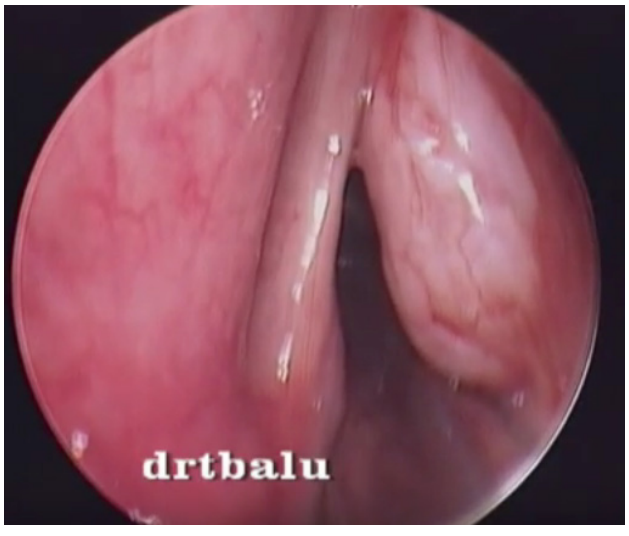


Figure showing the effects of not properly adjusting the anterior tilt screw of the chest piece. (Anterior commissure area is obscured)

Laryngeal wand is used for ablation of tissue. It should be remembered that coblator does not ablate cartilage, hence it cannot be used to ablate arytenoid cartilage. Irrigation should be set at the lowest level because of risk of aspiration. Frequent suctioning should be resorted to to remove saline and tissue debris.

Microlaryngeal wand can be used for more precise ablation.

One advantage that could be observed while using coblation for laryngeal surgeries is that there is no post operative oedema. This could be due to minimal collateral damage to adjacent structures.

Ideally a plane should be developed between the mass and the underlying portions of the vocal fold for successful and complete removal of the tumor mass. Dissection should follow this plane till the entire mass is removed. Inorder to develop a plane the mass should be medialised using a cup forcepts.

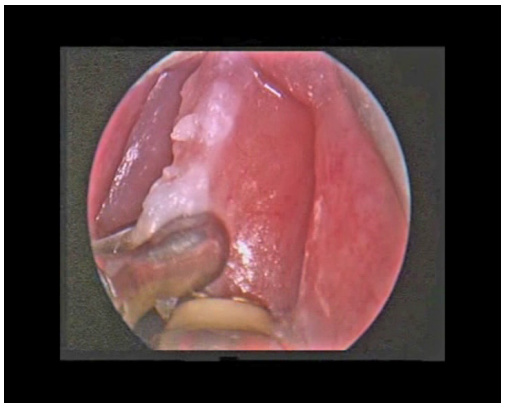


Figure showing mass in the vocal fold being medialized in order to create a plane for dissection

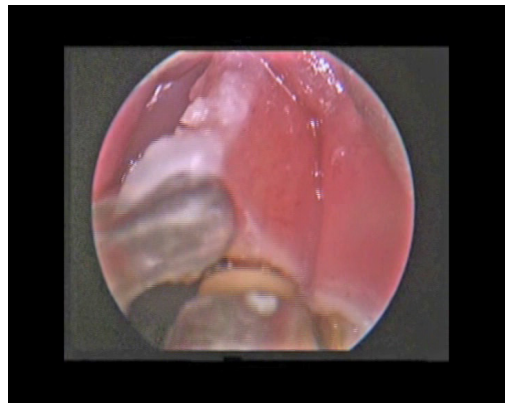
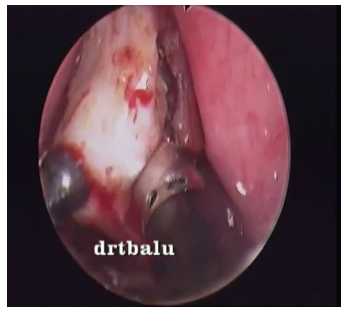
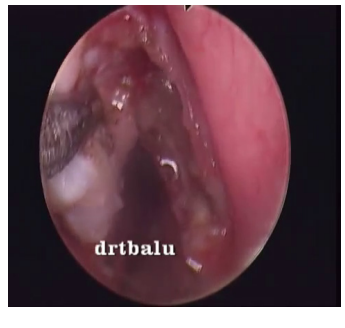
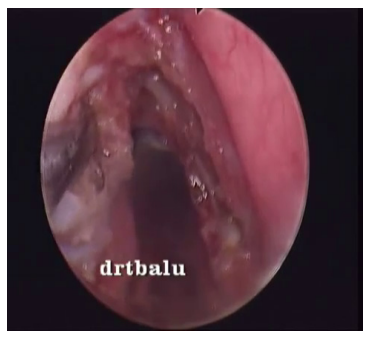


Figure showing dissection proceeding with a laryngeal wand after medialization of the vocal fold mass





Figures showing plane being created between the mass and the inner perichondrium of thyroid cartilage



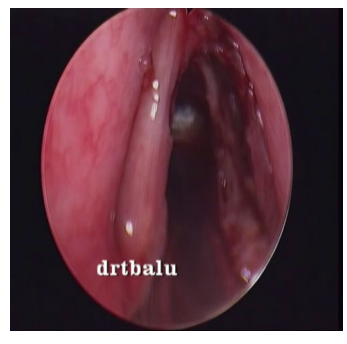
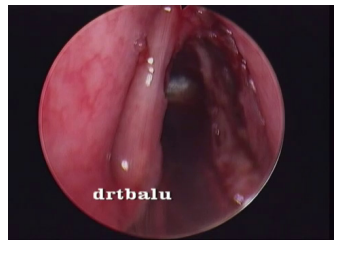
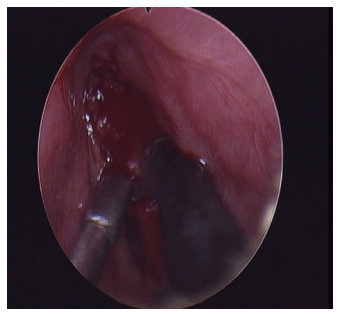


Figure showing the mass being removed in toto, and the end result of removal

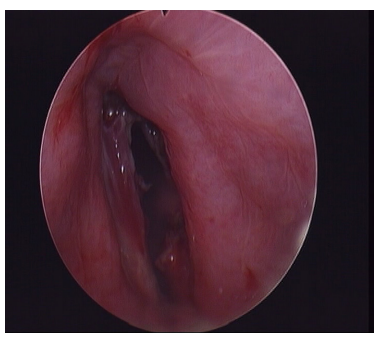


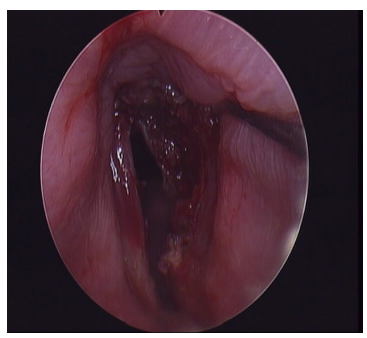
While performing endoscopic coblation cordectomy branches of external laryngeal vessels may cause troublesome bleeding. They can easily be controlled by coagulation / tamponade. The author has encountered one case of bleeding from external laryngeal vessels which took sometime to control in his series of 15 cases. Further evaluation is needed to ascertain the usefulness of this technology in managing vocal fold malignancies.

Here are some screenshots from the author's surgical clippings on the role of coblation in the management of vocal fold growth. This patient had growth right vocal cord. He refused to undergo any surgery that involved external approach. He consented to try out coblation ablation of the mass. He was informed of the risks involved in the procedure including the need to undergo salvage laryngectomy at a later date. He was convinced to undergo post op irradiation to which he consented. he has been under follow up for the last 1 year. He showed no evidence of recurrent / residual mass in the vocal cord till date.



Figures showing malignant growth right vocal fold and the same being ablated using laryngeal wand





Figures showing end result of coblation

References:

1. Spiegel JR, Sataloff RT. Surgery for carcinoma of the larynx. Gould WJ, Sataloff RT, Spiegel JR. Voice
Surgery. St. Louis: Mosby; 1993. 307-337.
2. De Diego JI, Prim MP, Verdaguer JM, Pérez-Fernández E, Gavilán J. Long-term results of open cordectomy
for the treatment of T1a glottic laryngeal carcinoma. Auris Nasus Larynx. 2009 Feb. 36(1):53-6. [Medline].
3. Jackson C. Ventriculocordectomy: a new operation for the cure of goitrous paralytic laryngeal stenosis. Arch
Surg. 1922. 4:257–274
4. Remacle M, Van Haverbeke C, Eckel H, et al. Proposal for revision of the European Laryngological Society
classification of endoscopic cordectomies. Eur Arch Otorhinolaryngol. 2007 May. 264(5):499-504.
[Medline].
5. Swarc BJ, Kashima HK (1997) Endoscopic management of a combined laryngocele. Ann Otol Rhinol Laryngol 106 :556–
559

Role of coblation in benign laryngeal lesions

Coblation is of immense value in the management of benign lesions involving the larynx. Obvious advantages of this technology being that it ablates tissue without abnormally increasing the surface temperature. There is hence absolutely nil risk of airway fire during the procedure. This technology has been effectively used to treat the following laryngeal lesions:

1. Papilloma of larynx

2. Laryngeal web

4. Cysts involving epiglottis

5. Benign vocal fold lesions like cyts / hemangiomas / nodules

Papilloma of larynx

Introduction:

Laryngeal papillomatosis is a chronic condition caused by human papilloma virus infections. About 100 different papilloma viruses has been identified. HPV virus 6 and 11 commonly affect the airway. These viruses are associated with lowest malignancy potential, whereas types 16 and 18 have the greatest malignancy potential.

Papilloma larynx usually involves vocal cords, false cords and epiglottis. These masses are friable and bleed on touch. It usually occurs in two forms:

1. Juvenile papilloma

2. Adult papilloma

Juvenile Papilloma of larynx:

This condition occurs in infants and children. Classic features of juvenile papilloma larynx include:

1. Multiple in nature

2. Aggressive in its behavior

3. Known to recur after successful surgical removal

4. Commonly caused by Human papilloma virus type 6 / type 1.

5. Infants get infected from infected mother's genitals during delivery

This type of papilloma is frequently localised in the larynx [1]. This condition can also undergo spontaneous remissions.

Clinical features:

1. Hoarseness of voice

2. Child may have difficulty while crying

3. When the masses enlarge in size airway compromise has been known to occur causing stridor

On examination these lesions apprear as whitish multiple friable masses. Commonly it involves true vocal cords / false cords and rarely epiglottis. These lesions have a prediliction to involve squamo columnar junctions.

Human papilloma virus:

This is a small DNA containing non enveloped, icosohedral (20 sided) capsid virus. The DNA inside the viron is double stranded and circular.

Figure showing multiple respiratory papillomatosis affecting true and false cords

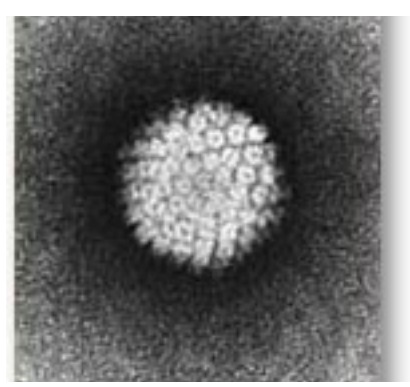


Figure showing Human papilloma virus

Nearly 100 different types of human papilloma viruses have been identified. Children affected with human papilloma virus 11 have more obstructive airway early in the disease [2].

Classically human papilloma virus infects the basal layer of the mucosa. The viral DNA enters these cells and gets transcribed into RNA. This RNA translates viral protein. After infection viral DNA can actively be expressed or exist as latent infection in the mucosa. During this latency period the mucosa remains clinically and histologically normal. During this latency period very little viral RNA is seen within the mucosa. Reactivation can occur at any time causing the disease to manifest itself. Human papilloma virus is part of the normal commensal in the laryngeal mucosa. HPV gets activated only in the presence of immunocompetence. Most of the individuals have HPV specific killer T cells.

Genomic architecture of Human papilloma virus:

Viral genome of Human papilloma virus has 3 regions:

1. The upstream regulatory region

2. E region / Early region. These are potential oncogenes which are responsible for active replication of the viral genome

3. L region / Late region. These genes are responsible for encoding viral structural proteins.

Human papilloma virus has the capacity to utilize the host replication genes to facilitate its own DNA replication. This virus induces epithelial proliferation by increasing the level of expression of epidermal growth factor or its ligands. It is also known to facilitate cellular proliferation by inhibiting p53 (tumor suppressor gene). This virus is also capable of inactivating retinoblastoma tumor suppressor protein (pRB). It is also known to cause degradation of TIP60 which is involved in the activation of apoptosis, enabling the infected cell to survive longer and to replicate. These viruses are also known to cause degradation of p130 which activates cell division by pushing cells in phase G0 to G1.
Ki67 expression is an important marker for mitotic activity which detects all stages of mitosis except G0 phase. Studies reveal that there is significant correlation between the level of expression of Ki67 [3] and recurrence / malignant transformation of respiratory papillomatosis.

Role of coblation in surgical management of laryngeal papillomatosis:

Microlaryngeal excision of these lesions is the standard treatment protocol. Various modalities of excision are being used including:

1. Cold steel excision

2. Microdebrider excision

3. Laser excision

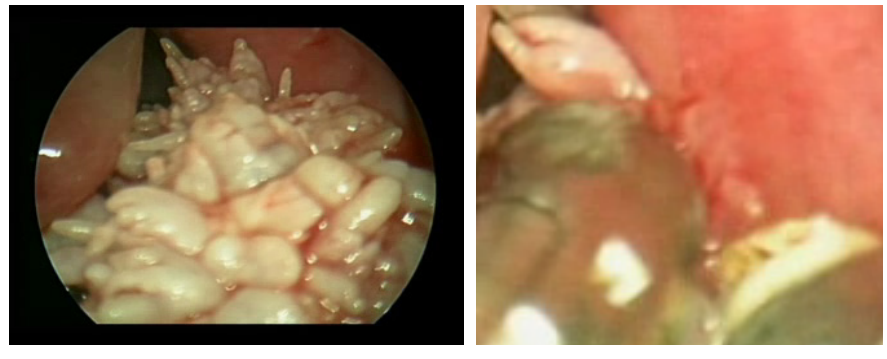
4. Excision using coblation

Obvious advantages of coblation in this scenario are:

1. Tissue ablation without much collateral tissue damage

2. Since ablation is performed by generation of plasma which occurs at low temperatures there is absolutely zero risk of airway fire.

3. Laryngeal and microlaryngeal wands used in surgery can be used for precise ablation. These wands are longer and hence can reach up to the subglottic area.



Figures showing multiple papilloma larynx being removed using laryngeal wand

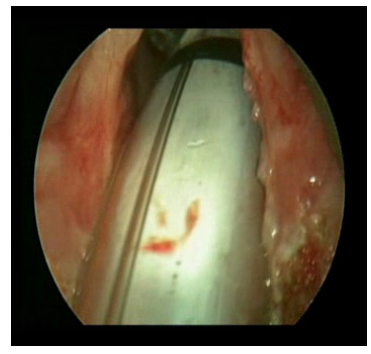


Figure showing larynx after removal of papilloma

Since there is very little damage to adjacent tissue, tissue oedema is also reduced. There is no threat of airway compromise due to tissue oedema as is the case with laser. Infact laser vaporization causes delayed oedema after a week / 10 days compromising the airway, hence patients need to be hospitalized and kept under observation during this period.

If possible it is better to avoid tracheostomy in these patients because papillomas have a tendency to recur around tracheostomy stoma. If airway is not compromised, then care should be taken to carefully intubate the patient under direct visualization using CMac video laryngscope. Intubation under vision causes less trauma and hence less bleeding during intubation in these patients.

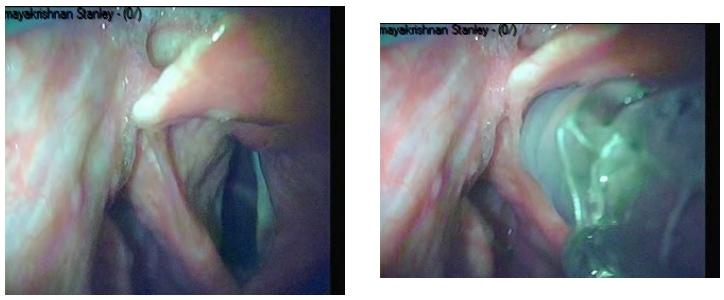


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Figure showing stages of intubation using CMac

Figure showing ET tube in situ

During the entire course of surgery it is better to keep the saline irrigation to coblator to a minimum inorder to minimize risk of aspiration during surgery.

Coblation in Micolaryngeal surgical procedures

For performing microlaryngeal surgeries Microlaryngeal wand (MLW) is ideal. This wand has a narrow shaft, longer than that of laryngeal wand which facilitates removal of lesions even at the level of anterior commissure. It can reach up to the subglottic area [1]. This wand is designed for precise ablation and coagulation of the lesion. Default console settings [2] for this wand is Coblate 7 Coagulate 3. As soon as the MLW is connected to the console this default settings is set. In exceptional cases this setting can be manually overridden.

Image showing the default console settings for microlaryngeal wand

Tip:

While performing microlaryngeal surgeries using coblation technology the patient should be placed in head down position (Trendelenberg). This position would prevent irrigated saline to flow into the oropharynx thereby protecting the airway.

Standard cuffed microlaryngeal endotracheal tubes would suffice. For additional protection wet cottonoids can be placed gently around the cuff.

If needed jet ventilation can also be used along with this device.

Procedure:

Patient is intubated using a microlaryngeal endotracheal tube.

Features of Microlaryngeal endotracheal tube:

1. This tube has a small internal and external diameter
2. Its internal diameter ranges from 4-6mm
3. It is 30 cms long with standard cuff
4. The cuff when inflated lies between arytenoid cartilages, leaving anterior 2/3 of glottis unobscured for surgery

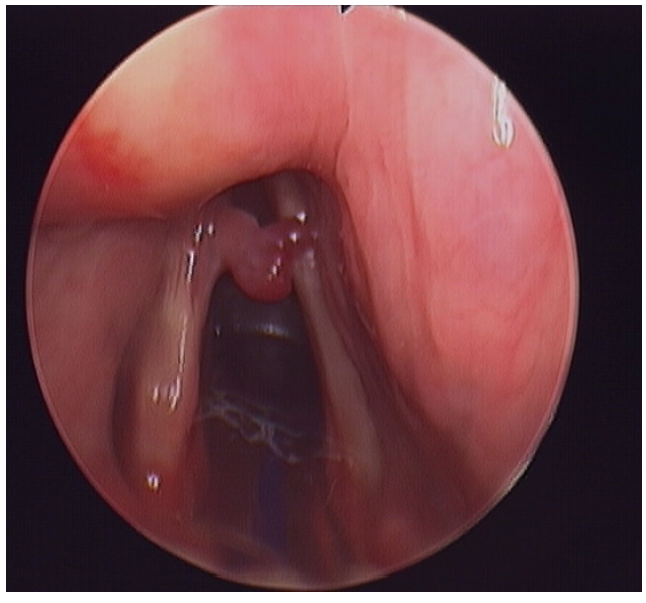


Image showing an ideally placed microlaryngeal intubation tube with inflated cuff between arytenoids. Note the entire anterior 2/3 of larynx is visible and accessible

Procedure:

To facilitate ablation the tip of microlaryngeal wand should be held as close to the target tissue as possible. Care should be taken while ablating to spare the adjacent normal tissue. The ablate pedal (yellow) should be pressed briefly for about 1-2 seconds for ablation to occue. The process of ablation is continued briefly by pressing the yellow pedal for allowing tissue digestion at the tip of the electrode.

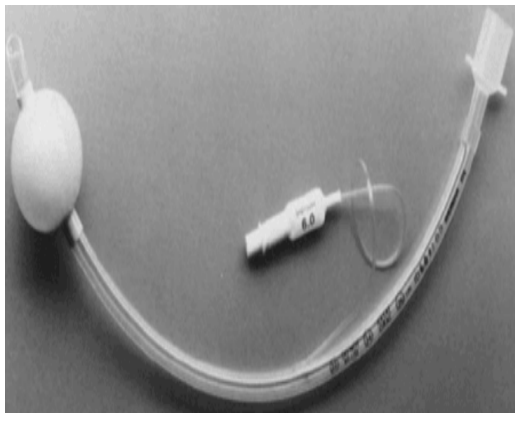


Figure showing microlaryngeal endotracheal tube

The position of the wand electrode should be carefully monitored at all times. Dabbing action should be used to create contact between the electrode and target tissue.. This should be rather brief 1-2 seconds only [3]. Non targetted tissue should not come into contact with the metal electrode. The wand tip should not be rubbed over the target tissue because the ablated tissue could clog the irrigation / suction port of the wand.
For coagulation of bleeding points the tip of the wand should be in contact with the bleeding vessel and the coagulate pedal should be pressed.

Figure showing angioma of vocal fold being ablated using microlaryngeal wand

Ablation should proceed in all direction of the mass

End result after ablation of the mass (angiomatous polyp)

Advantages of coblation in microlaryngeal surgeries:

1. Damage to adjacent normal tissue is minimal or negligible

2. Mucosal surface of vocal folds heal rather quickly as evidenced by the return of normal mucosal wave pattern within 6 weeks following surgery

3. There is absolutely zero risk of airway fire

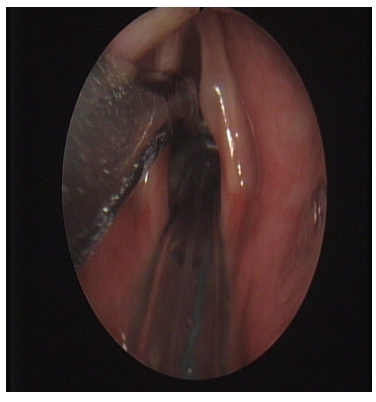
4. There is absolutely negligible bleeding during surgery

5. Healing is rapid because formation of exudate is rather minimal

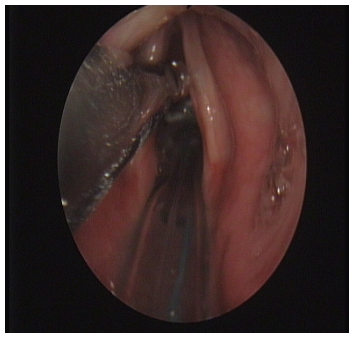
6. Even bilateral vocal fold lesions can be addressed in the same sitting because the risk of web formation is rather minimal because of reduced exudate formation

7. Anterior commissure lesions can be addressed without fear of blunting

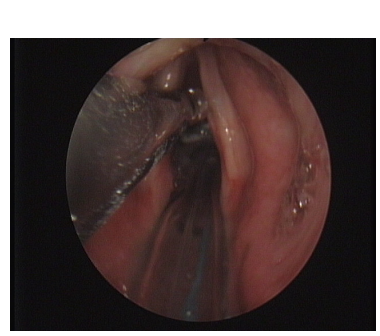
Removal of vocal fold cyst using coblation:



Figures showing vocal fold cyst with the microlaryngeal wand being placed as close to the cyst as possible



Figures showing the vocal fold cyst being sucked into the wand by the negative pressure exerted by the suction portal. This is the precise time to press the ablate pedal



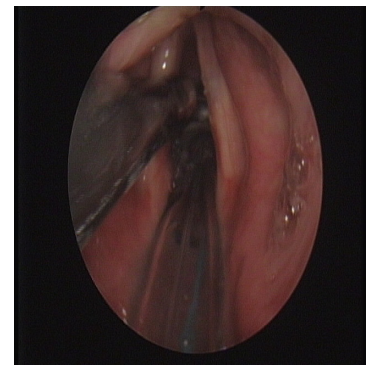


Figure showing vocal fold cyst ablation being completed

References:

1.http://opendepot.org/2129/1/wands.pdf

2. https://www.smith-nephew.com/global/surgicaltechniques/ent/precise_mlw_surgicaltechnique_45403c.pdf

3. http://jorl.net/index.php/jorl/article/view/coblation_wands

Role of coblation in Lingual tonsillectomy

Introduction:

Lingual tonsils are normal components of Waldayer's ring. This is a collection of lymphoid tissue located at the base of tongue. They are two in number situated posterior to the circumvallate papillae of the tongue. They lie just anterior to the vallecula. Lingual tonsils are divided in the midline by the presence of median glosso epiglottic ligament. Lingual tonsil tissue rests on the basement membrane of fibrous tissue which could be considered analogous to tonsillar capsule of palatine tonsil. Hypertrophy of this lymphoid tissue are rare in children but rather common in adults [1]. It is highly prevalent in atopic individuals. Clinically lingual tonsillar enlargement is not commonly appreciated during routine clincial examination. It needs a discerning eye for routine identification. Many of these patients are asymptomatic.

Rarely enlarged lingual tonsils can cause:

1. Globus sensation

2. Change in voice

3. Chronic cough

4. Choking attacks

5. Dyspnoea (rare)

6. Sore throat (acute phase)

7. Leukocytosis (acute phase)

8. Abscess formation

9. Obstructive sleep apnoea

10 Recurrent acute epiglottitis

Blood supply of lingual tonsil [2]:

Arterial:

Ascending pharyngeal

Dorsal branch of lingual artery

Venous drainage: Is via the plexus of veins present in the tongue base

Lymphatic drainage:

Lymphatics from lingual tonsil drain into suprahyoid, submaxillary and upper deep cervical group of nodes.

Innervation:

Glossopharyngeal nerve

Superior laryngeal branch of vagus nerve

Causes of lingual tonsil hypertrophy:

1. Compensatory hypertrophy following adenoidectomy [3]

2. GERD (common in children)

3. Chronic infections

4. Impacted foreign body like fish bone

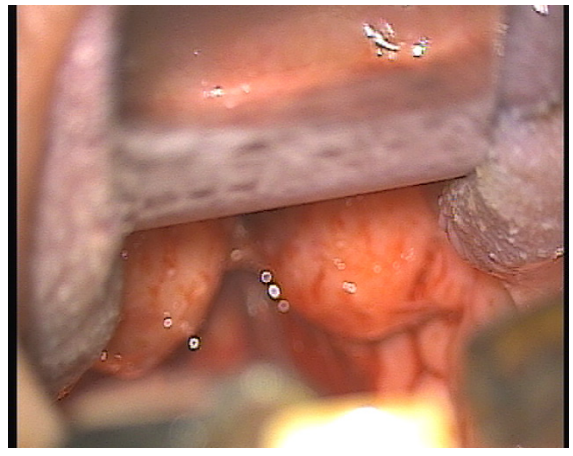


Image showing hyertrophied lingual tonsils

Clinical gradation of lingal tonsil hypertropy [4]:

Lingual tonsils can be graded endoscopically on a scale ranging between 0 - 4. This grading is based on their distribution and visibility of vallecula and posterior third of the tongue.

Grade 0 : No lingual tonsil enlargement

Grade 1: Lingual tonsil + in the tongue base. Vascularity seen

Grade 2 : Lingual tonsil seen in the tongue base. Vascularity no visible

Grade 3: Diffuse lingual tonsillar enlargement with vallecula not visible

Grade 4: Diffuse lingual tonsillar enlargement with invisibility of epiglottis.

Indications for surgical management of lingual tonsil:

1. Obstructive sleep apnoea caused due to enlarged lingual tonsil. This should be considered as an absolute indication.

2. Symptomatic enlarged lingual tonsil not responding to medical management including a course of antireflux therapy

3. Recurrent attacks of epiglottitis (possible foci from lingual tonsil)

Surgical management of hypertrophied lingual tonsil involving the following technologies:

1. Conventional excision

2. Cryosurgery

3. Debrider

4. Coblation

Advantages of coblation technology in removal of lingal tonsil are:

1. Bloodless field

2. Complete ablation is possible

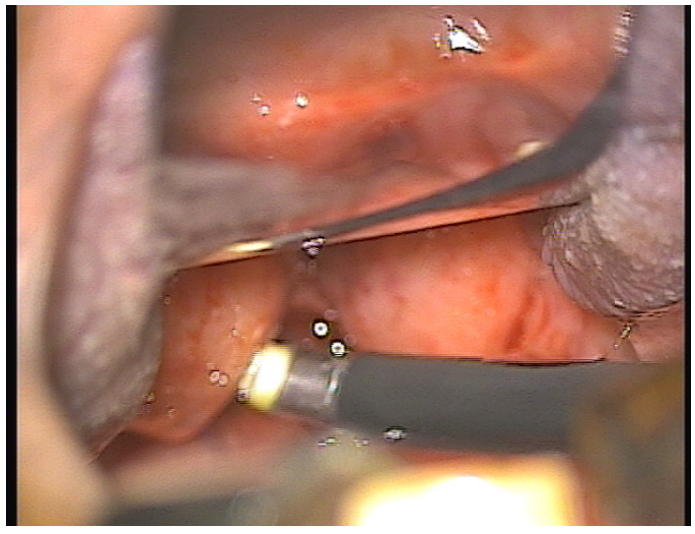
3. Less post op oedema

4. Post op pain lesser than that of other procedures

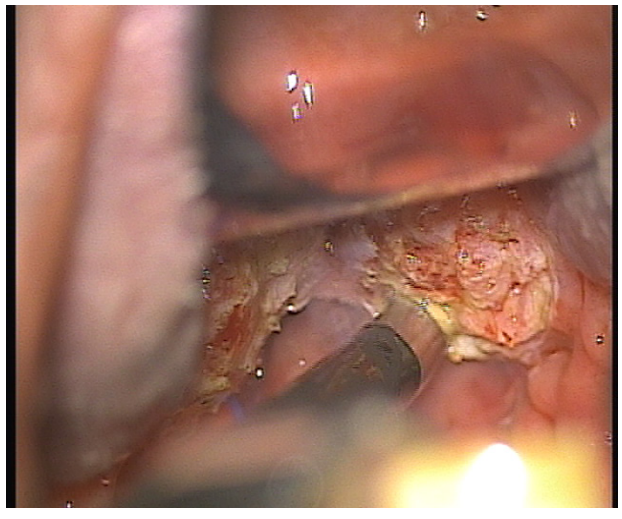
Procedure:

Patient is put in tonsillectomy position. Mouth is opened using Boyles Davis mouth gag. Operating microscope is used to visualize the enlarged lingual tonsil. Evac 70 tonsillar wand is used for surgical procedure. Lymphoid tissue is really easy to ablate. It really melts on contact with plasma generated by the wand. Fibrous tissue over which lingual tonsil tissue lies is rather resistant to ablation. Lingual musculature is hence left intact even after complete removal of lingual tonsillar tissue. Since lingual musculature is left undisturbed, post operative pain is less than that of other procedures.

Evac 70 tonsil wand is used for ablating lingual tonsil tissue. Ca should be taken to use copious irrigation as the wand is likely to get-clogged with ablated tissue.



Evac 70 tonsil wand is seen ablating lingual tonsil



Picture showing the end result of lingual tonsil ablation. Note the lingual musculature after removal of lymphoid tissue

It should also be noted that it is imperative to perform tonsillectomy if tonsil is already present to reduce chances of recurrence.

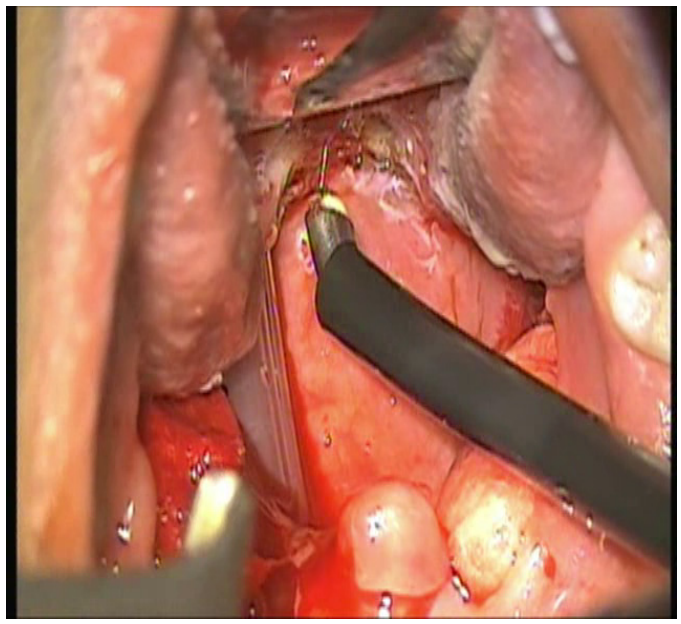


Figure showing completed lingual tonsillectomy. Note pharyneal tonsils have already been removed and the fossa packed with cotton balls

Tip:

While holding the wand it should be held in such a way that dripping saline gets into contact with the active electrode for adequate plasma generation. Ideally it should be held in such a way that the active electrode is horizontal to the tissue being ablated.

References:

1. Golding-Wood DG, Whittet HB. The lingual tonsil. A neglected symptomatic structure? J Laryngol Otol 1989;103:922-5.

2. Thiagarajan, Balasubramanian, and Karthikeyan Arjunan. “Hypertrophied lingual tonsil an interesting case report and a review of literature.” (2012).

3. N Jesberg, Chronic hypertrophic lingual tonsillitis, Arch.otolaryngology.64 (1956) 3-13

4. Sung M, Lee W, Wee J, Lee C, Kim E, Kim J. Factors Associated With Hypertrophy of the Lingual Tonsils in Adults With Sleep-Disordered Breathing. JAMA Otolaryngol Head Neck Surg. 2013;139(6):598-603. doi:10.1001/jamaoto.2013.3263.

Role of coblation in Tongue base reduction

Introduction:

Potential sites of obstruction in obstructive sleep apnoea include:
1. Nose
2. Palate
3. Tongue base
4. Lateral pharyngeal wall collapse

Among these factors tongue base happens to be a critical area of obstruction at the level of hypopharynx. Lateral cephalometric radiography helps in identifying tongue base obstruction. Mandible and tongue are major determinants of airway dimension. Genioglossus advancement used to address this issue causes a stretching effect on lingual musculature limiting its posterior displacement during sleep. This procedure needs external incision and a prolonged surgical procedure. With the advent of coblation technology tongue base can be selectively reduced without threat of bleeding and tongue oedema. This procedure can also be combined with the traditional Uvulo palato pharyngo plasty procedure also.

Tongue base reduction using radiofrequency was first introduced by Powel in 1999 [1]. Powel etal estimated a median reduction of tongue base volume of 17% with a maximum reduction of 29%. These values have not be corraborated by others. STUCK etal [2] could not verify actual reduction of tongue base volume / increase in retrolingual space. They attributed symptomatic relief following the procedure due to tissue stabilization caused by scarring dur to the procedure.

Basic advantage of coblation in tongue base reduction procedures is that there is absolutely no risk of tongue oedema following the procedure.

Tongue base reduction using Evac 70 Tonsillectomy wand: This procedure is also known as (SMILE) submucosal minimally invasive lingual excision.

This procedure is preformed under general anesthesia. Patient is positioned in tonsillectomy position. The tongue base area that is to be ablated is marked using GV paint.

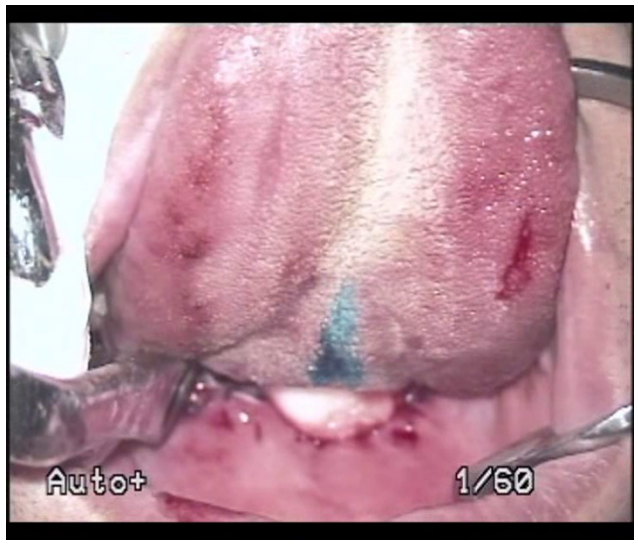


Figure showing posterior third tonge tissue which needs to be ablated marked with GV paint. Note: The marking is triangular in shape with apex pointing towards foramen ceacum. Moist cotton ball is placed behind the marking to protect the adjacent areas from collateral damage.

Figure showing Evac 70 tonsillar wand being used

Image showing sectioning of the marked area in the posterior third of the tongue

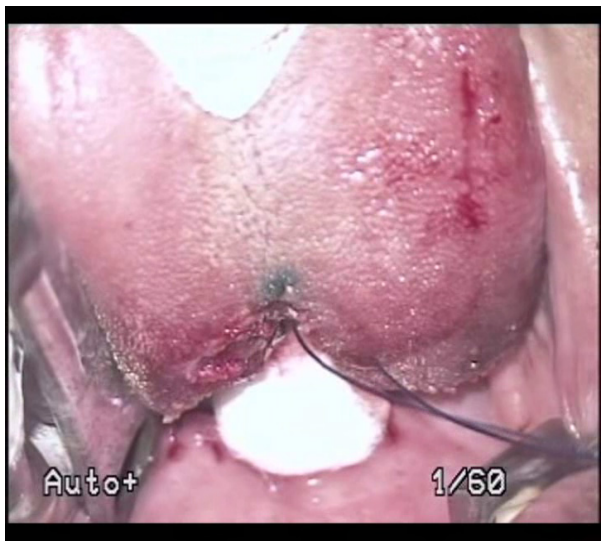


Image showing edges of the resected tongue base sutured

Coblation assisted Lewis and MacKay operation:

This surgical technique involves midline glossectomy combined with lateral coblation channelling. Another modification of this procedure involves channellling of posterior third of tongue instead of midline glossectomy.

Reflex ultra 55 wand is used for tongue channelling procedures.

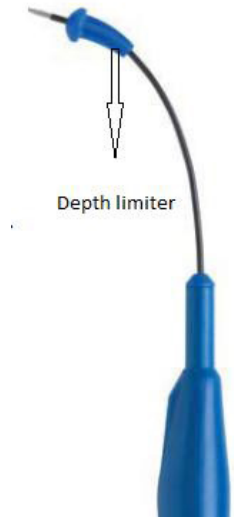


Figure showing Reflex Ultra 55 channelling wand

These wands are needle wands with depth limiter which helps in monitoring the depth of submucosal penetration [3].

Tongue channelling can be combined with tongue base resection. Reflex ultra 55 wand is used to reduce lateral bulk of tongue. After completion of tongue base sectioning, reflex ultra 55 channelling wand's depth limiter is adjusted to be about 2 mm. It is used to penetrate the lateral border of tongue and coblation is applied at a setting of 6. Three points are choosen along the lateral border of tongue and the channelling wand is used to ablate. Ablation is performed on both sides. Ablation causes fibrosis of lingual musculature thereby cause reduction in the tongue bulk. Currently available reflex ultra wands are provided with saline irrigation facility. If older version of these wands are used then saline should be infiltrated into the area before ablation is commenced.

Tongue channelling can alone be performed without resection of tongue base. The same wand can be used to ablate posterior third of tongue also. Three points are choosen in the posterior third of tongue. The first point is just behind the foramen cecum, while the other two are cited along the lateral border of posterior third of tongue. In other words the three points of the triangle marked in the posterior third of the tongue is ablated using reflex ultra 55 coblation wand.

Tongue channelling done in the anterior portion of lateral border of tongue

Figure showing tongue channelling beinf performed in the posterior portion of lataral margin of tongue

Usual time taken for optimal benefit following tongue channelling could range between 4-6 weeks. One of our patients took nearly 2 months for optimal benefit to occur following tongue channelling.

Advantages of tongue channelling:

1. Can be performed as a day care procedure

2. Can be performed under local anesthesia

3. Tissue destruction is not extensive

4. Bleeding is minimal

5. No risk of upper airway obstruction due to tongue oedema

One major drawback of this procedure is the amount of tissue destruction cannot be accurately predicted. This procedure needs to be repeated if effect is not optimal even after 6 weeks.

Seven port coblation tongue channelling Procedure [4]:

This procedure can be performed under local anesthesia. Reflex Ultra 55 wand is used for this procedure. Seven channels should be created in the tongue for channelling purpose. These channels include:

1. Three midline channels

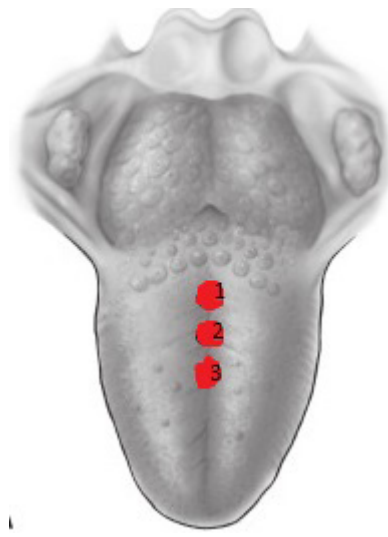


Figure showing three midline channels

2.

Two lateral channels on each side

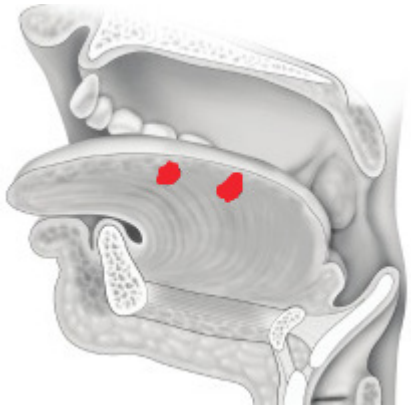


Figure showing lateral channel port

The three midline channels starts from 1 cm in front of apex of the circumvallate papillae, moving forwards by 1-2 cms. Anterior most midline channel should be sited atleast 2.5 cms from the tip of the tongue.

The lateral channels are created in the axial plane with entry points created at the junction of dorsal and lateral tongue mucosa. The reflex ultra probe should ideally be directed towards the posterior portion of the tongue.

This seven channel coblation procedure treats both the middle and posterior thirds of tongue rather than focussing on the posterior third alone [5].

The availability of multiple procedures for tongue size reduction creates a healthy dilemma in the mind of a surgeon which one to follow. It is always prudent is to start off with the modality which is least invasive and causes the least morbidity and then proceed to other more adventurous and more invasive procedures.

In the impression of the author it is best to start the treatment with the seven channel lingual coblation, and after assessing the benefits then other more invasive procedures like tongue base resection, and genial tubercle advancement procedures can be attempted.

References:

1. Powell NB, Riley RW, Guilleminault C (1999) Radiofrequency tongue base reduction in sleep-disordered breathing: a pilot study. Otolaryngol Head Neck Surg 120:656–664

2. Stuck BA, Köpke J, Hörmann K, Verse T, Eckert A, Bran G, Düber C, Maurer J (2005) Volumetric tissue reduction in radiofrequency surgery of the tongue base. Otolaryngol Head Neck Surg 132:132–135

3. Thiagarajan, Balasubramanian. “Coblation wands” Otolaryngology online journal [Online], Volume 4 Number 1.5 (13 March 2014)

4. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3544378/

5. Salinas NL, Barrera JE. Coblation Lesion Formation in a porcine tongue model. Otolaryngol Head Neck Surg. 2010;143:448–53.

Coblation in Uvulopalatopharyngoplasty

Introduction:

Currently UPPP (Uvulopalatopharyngoplasty) is the commonly performed surgical procedure for Obstructive sleep apnoea syndrome (OSA) [1]. This procedure was first performed by Fugita in 1981 [2]. Classically UPPP involves tonsillectomy, trimming and reorientation of anterior and posterior tonsillar pillars, combined with excision of uvula and posterior portion of palate.

Various modifications of the above procedure has been attempted to improve results. These include:

1. Complete removal of uvula and distal palate

2. Removal of part of palatopharyngeus muscle and use of uvulopalatal flap

3. Use of coblation to perform UPPP

4. Laser assisted uvulopalatoplasty [3]

Coblation Uvulopalatopharyngoplasty - The Procedure:

This modification is also Robinson's Modification. The steps include -

1. General anesthesia - Nasal / Oral intubation

2. Tonsillectomy with preservation of pillar mucosa

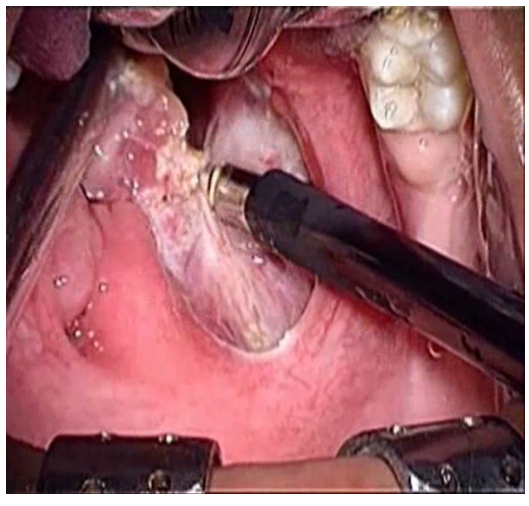


Figure showing Tonsillectomy being performed with preservation of pillar mucosa

3. Caudal traction of uvula by elevating triangular shaped flap of mucosa on either side.

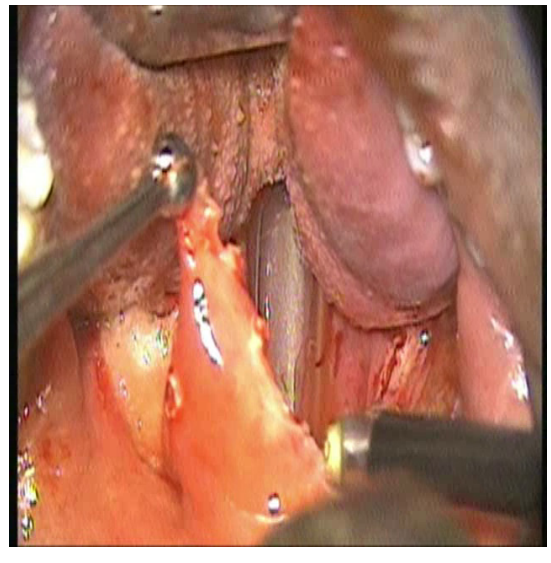


Figure showing elevation of triangular mucosal flap on either side of Uvula

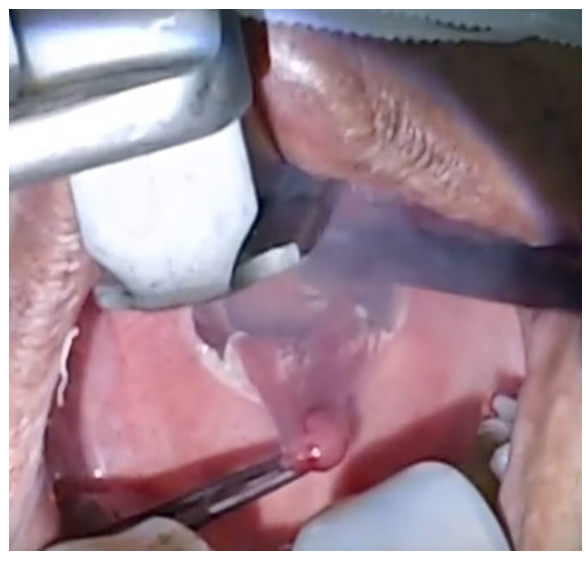
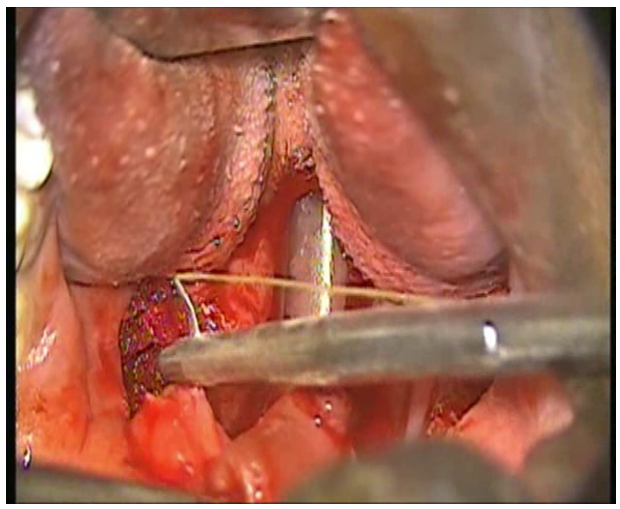


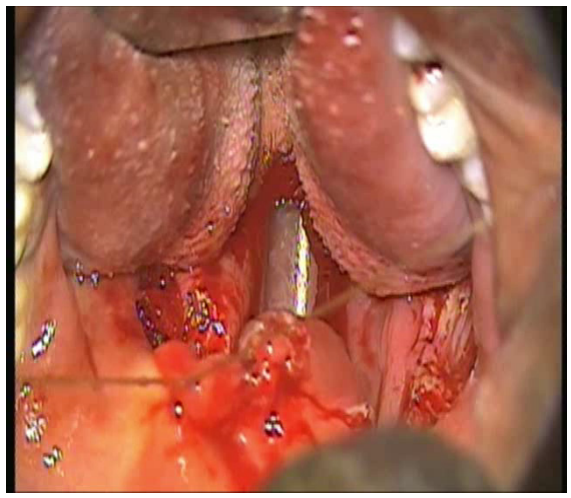
Figure showing triangular flaps elevated on both sides

Bilateral resection of supratonsillar pad of fat.

Anterior and posterior pillars are sutured together. Redundant uvular mucosa is sutured together thereby everting the soft palate. This opens up the nasopharyngeal airway.



Para Uvular wedge created is sutured with that of anterior pillar of tonsil everting the soft palate



Uvular stump eversion stitch being applied. This stitch opens up the nasopharynx

Uvular eversion stich is applied from the tip of the uvular stump to the anterior pillar of tonsil. This suture everts the uvular stump thereby opening up the nasopharynx.

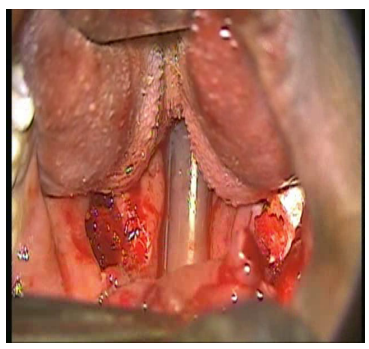


Figure showing the result of uvular eversion

Pillar suturing:

Suturing both anterior and posterior pillars together is the next step. This should be done on both sides.

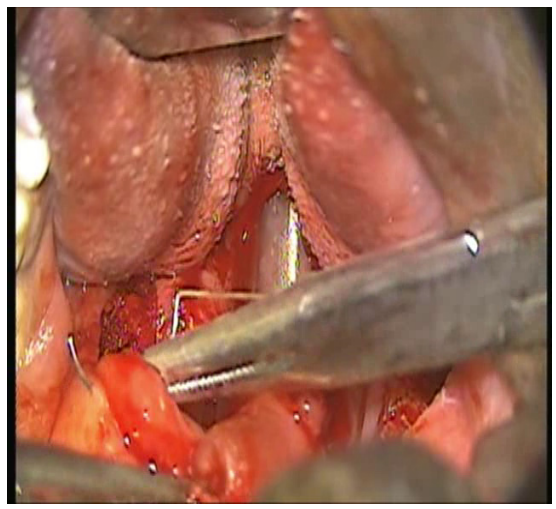
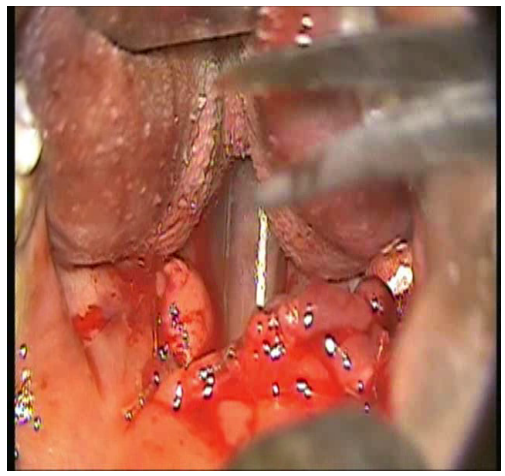


Image showing pillar suturing being performed



End result after surgery

Robinson modified uvulopalatopharyngoplasty:

Major advantage of this procedure is that it opens the lateral velopharyngeal ports. In this procedure only the tonsils and submucosal fat are resected. This should indeed be considered as reconstructive surgery and not ablation.

According to Friedmann 25% of patients with obstructive sleep apnoea had problems related to tonsils / palate. The remaining 75% of OSA patients had problems pertaining to tongue and tongue base.

He devised a simple observational classification of tongue position in relation to soft palate which could be used as a predictor for OSA. Tongue position is classified into 4 types:

Type I tongue position is normal and does not cause symptoms, while type IV tongue position causes severe problems at the level of tongue base causing OSA.

1

Diagramatic representation of all 4 tongue positions described by Friedman

Coblation as a tool can easily address tonsil, palate, and tongue. Hence it is an excellent tool in the surgical management of obstructive sleep apnoea.

No single treatment modality is successful in the management of OSA. It should be managed according to the area of obstruction and could involve multiple surgical procedures since obstruction can exisit at multiple levels.

References:

1. Elshaug AG, Moss JR, Southcott AM, Hiller JE. Redefining success in airway surgery for obstructive sleep apnea: a meta analysis and synthesis of the
evidence. Sleep 2007;30(4):461-467.

2. Fujita S, Conway W, Zorick F, Roth T. Surgical correction of anatomic abnormalities in obstructive sleep apnea syndrome: uvulopalatopharyngoplasty. Otolaryngol Head Neck Surg1981;89(6):923-934.10.

3. Kamami YV. Laser CO2 for snoring: preliminary results. Acta Otorhinolaryngol Belg 1990; 44 : 451-6.

Malignant tumor of oropharynx - Can it be ablated ?

Introduction:

Soft palate is considered to be a portion of oropharynx. Malignant tumors involving soft palate accounts for roughly 2% of all head and neck malignancies. Squamous cell carcinoma happens to be the predominant histological type [1]. Soft tissue tumors are usually bilateral. Since soft palate plays an important role in swallowing and phonation, resection of this area is difficult to reconstruct functionally. Velopharyngeal insufficiency is rather common in these patients. Tumors involving this area usually present with early lymph node invovlement (usually bilateral). Convenionally radiotherapy has been the treatment of choice for soft palate malignancies and surgery was used for rescue purposes in radiation failed cases. Irradiation alone is not sufficient in managing these patients [2].

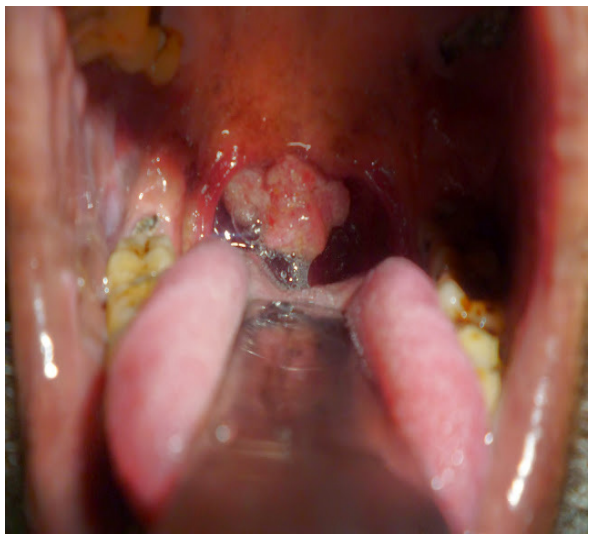


Figure showing malignant growth involving soft palate

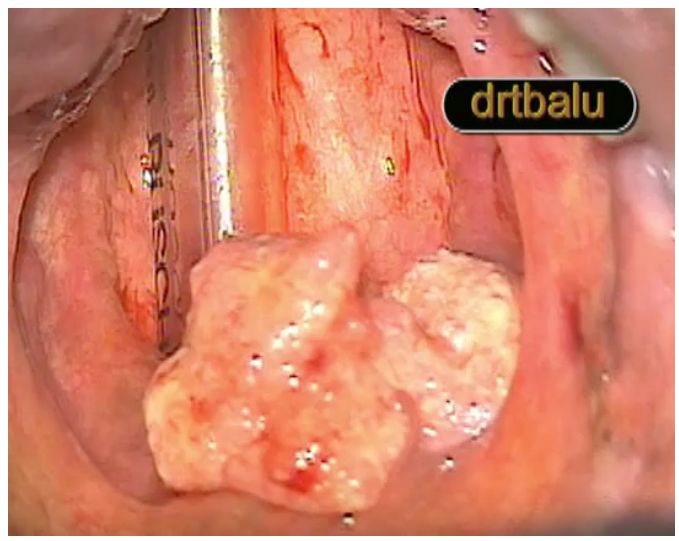
Synchronous or metachronous tumors along with soft palate growth is also common.

Surgical ablation of soft palate malignancy:

This is not popular because of the difficulties involved in surgical reconstruction of this area with reasonable functionality. Author attempted to resect malignant tumor involving soft palate using coblation technology. Surgery was attempted after getting consent from the patient. The plan was to resect the tumor completely and subject the patient to irradiation of the primary site and neck. This patient did not manifest with nodal involvement as revealed by CT scan of neck.

Procedure:

Ablation was performed using coblator under general anesthesia. Evac 70 tonsillar wand was used for this purpose. Patient was positioned in tonsillectomy position. The limits of the tumor was assessed by careful palpation. The entire surgery was performed under microscopy. Advantage of using microscope in this procedure is that tumor margins could be assessed with reasonable degree of accuracy.



Microscopic view of the tumor involving soft palate

Evac 70 tonsillectomy wand is used for ablation purpose. Bleeders if any should be secured by pressing the blue pedal of coblator while keeping the wand in contact with the bleeder.

Tumor was ablated starting from its medial border. Care is taken to ensure adequate surgical margin is left.

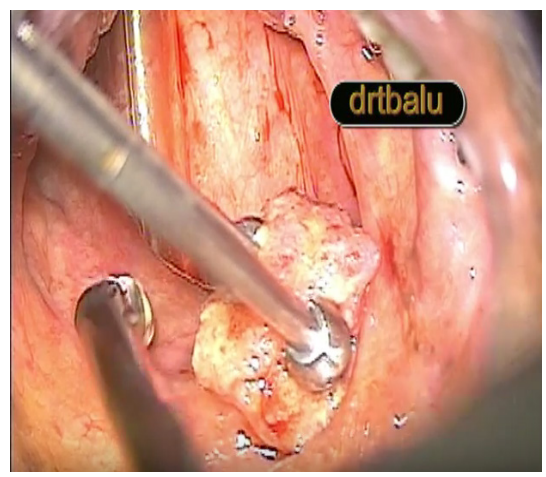


Image showing the mass being held with a button forceps
Tonsil wand could also be seen

In authors opinion coblation technology can be used to ablate oropharyngeal malignant tumors up to T3 staging.

TNM staging for Oropharyngeal malignant tumors:

Tx - Primary tumor cannot be accessed

T0 - No evidence of primary tumor

Tis - Carcinoma in situ

T1 - Tumor greater than 2 cm in its greatest dimension

T2 - Tumor more than 2 cms but less than 4 cms in its greatest dimension

T3 - Tumor more than 4 cms in its greatest dimension or extension into lingual surface of epiglottis. This stage is moderately advanced local disease.

T4a - Tumor invading larynx, deep extrinsic muscles of tongue, medial pterygoid, hard palate or mandible

T4b - Tumour invades lateral pterygoid muscle, pterygoid plates, lateral nasopharynx, skull base, or enclosing internal carotid artery

Regional Nodes:

Nx - Regional node involvment cannot be assessed

N0 - No regional node involvement

N1 - Metastasis in single ipsilateral node about 3 cms in its greatest dimension.

N2a - Metastasis into single ipsilateral node of more than 3 cms but less than 6 cms in size

N2b - Metastasis into multiple ipsilateral nodes none of which are more than 6 cms in size

N2c - Metastasis into bilateral or contralateral nodes, none of which are more than 6 cms in size.

N3 - Metastasis into a neck node the size of which is more than 6 cms

Metastasis:

M0 - No distant metastasis

M1 - Distant metastasis is present

Author operated 8 patients with malignant growth soft palate. All of these patients had squamous cell carcinoma. Tumor staging of operated patients ranged from T1 - T3. One patient had neck node involvement on the ipsilateral side and that patient underwent conservative block neck dissection while all others underwent irradiation (full course) of the primary site as well as the neck following successful ablation of the tumor mass. All these patients are being followed up regularly. The maximum period of follow up was 1 1/2 years. There was no evidence of tumor recurrence or metastasis during this period.

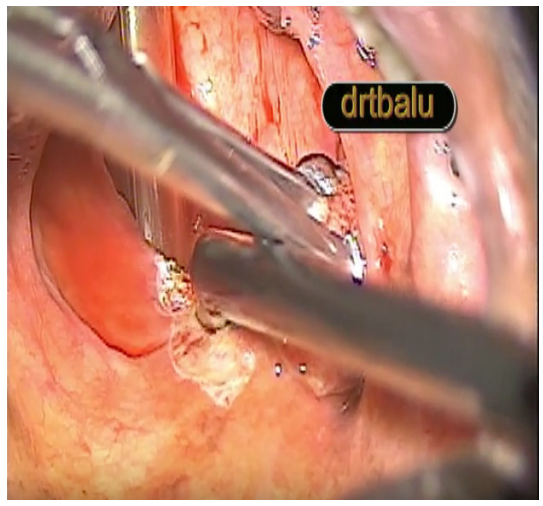


Figure showing the begining of the dissection process

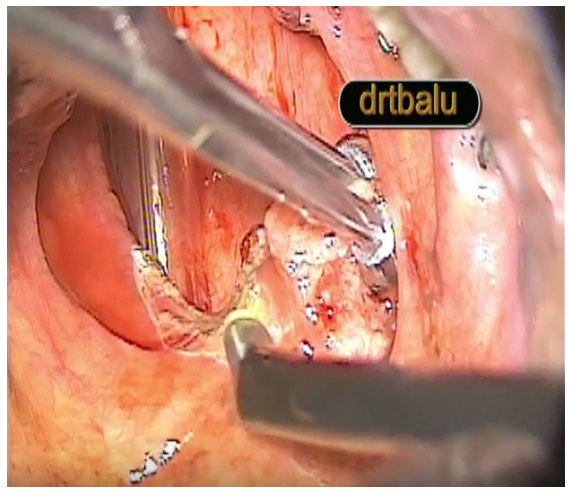


Figure showing mass being mobilised and dissected

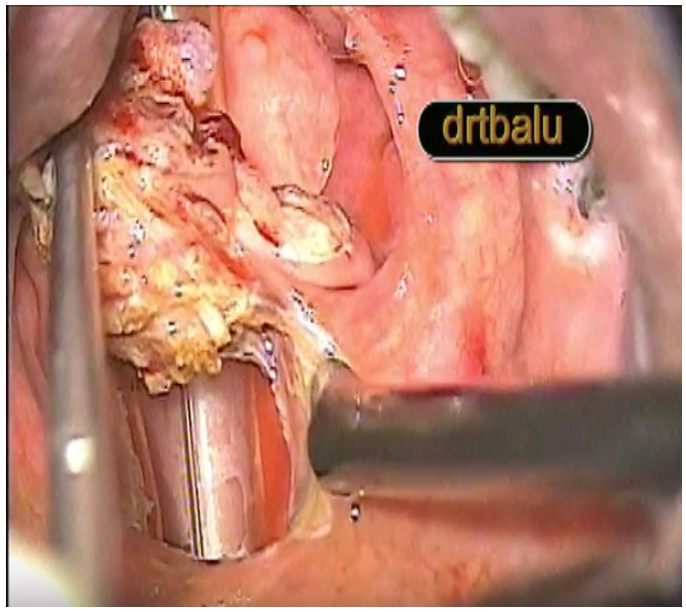


Figure showing mass about to be resected

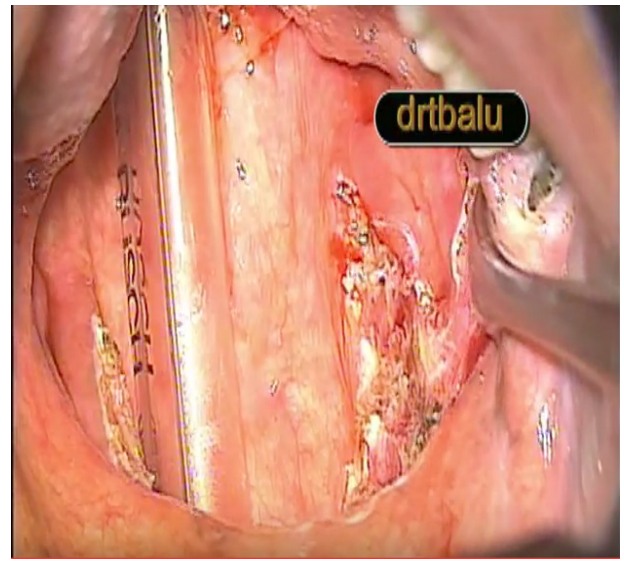
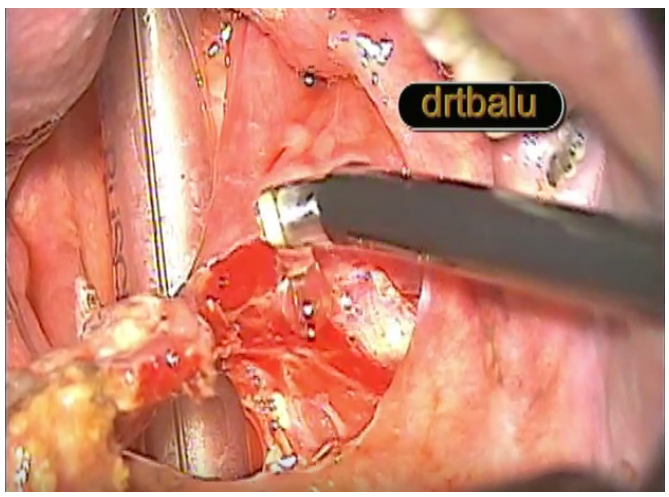


Figure displaying completeness of resection



1 year post operative

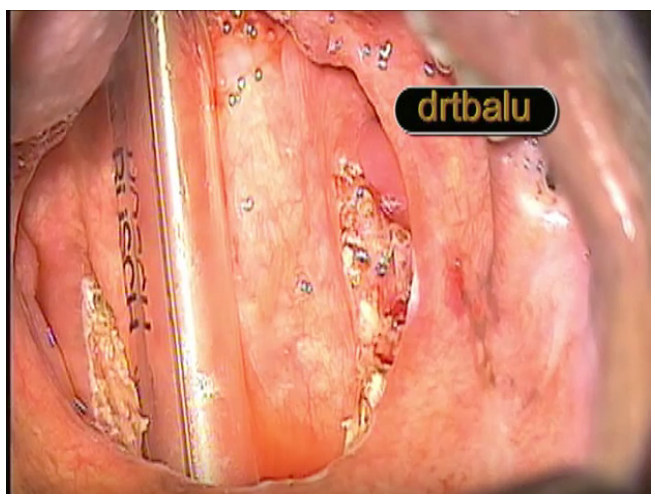


Figure showing oropharynx after resection of the mass

Views expressed here are purely from the experience of the author. Multicentre trials are necessary to validate the effectiveness of this technology in managing patients with malignant growth involving oropharynx.

One comparative study between the effectiveness of carbondioxide laser resection and coblation resection of oropharyngeal tumors indicates that this technology holds lots of promise provided wand design improvements take place [3].

Conclusion:

Advantages of coblation technology in managing oropharyngeal malignant tumors include:

1. Relatively bloodless field

2. Mucosal healing is better because of less collateral damage to adjacent normal tissue

3. Since this surgery is being performed under microscopy tumor margins can be adequate

4. Eventhough it is a blunt instrument, author did not face any difficulty with the plasma wand as far as precision is concerned.

5. The wand can also be bent to suit oropharyngeal anatomy

References:

1. http://www.scielo.br/pdf/rboto/v70n6/en_a09v70n6.pdf

2. Erkal HS, Serin M, Amdur RJ, Villaret DB, Stringer SP, Mendenhall WM. Squamous cell carcinomas of the soft palate treated with radiation therapy alone or followed by planned neck dissection. Int J Radiat Oncol Biol Phys 2001; 50:359-66.

3. Carney, A. Simon, et al. “Radiofrequency coblation for the resection of head and neck malignancies.” Otolaryngology--Head and Neck Surgery 138.1 (2008): 81-85.

Rhinophyma Excision Role of Coblation

Introduction:

The term Rhinophyma originates from the Greek term “rhis” meaning nose and “phyma” meaning growth. [1] This condition is characterised by thickening of skin over the nose due to soft tissue hypertrophy. This condition is 5 times more common in males than in females. This is very rarely seen in children. [2] This condition is considered as end stage of sebaceous overgrowth and scarring from poorly controlled acne rosacea. This condition is also referred by the term “W.C. Fields nose”. This condition is characterised typically by hypertrophic nodular growths in the distal half of the nose. The nose hence becomes ultimately fibrous and inflammed. The color of the skin usually changes to deep red / purple due to the presence of diffuse telengiactesis. Virchow has been credited for having correctly associating rhinophyma with acne rosacea in 1846. [3] Eventhough acne rosacea is common in women, progression to facial skin thickening and Rhinophyma is common in men [4]. This could probably be attributed to androgen influence.

Clinical features:

Rebora’s description[5] of various stages of Rhinophyma:

Stage I:
This stage is characterized by frequent episodes of facial flushing. According to Wilkin Rosacea is essentially a cutaneous vascular disorder hence flushing happens to be the first stage in the pathogenesis of Rhinophyma.

Stage II:
Increased vascularity leads to this stage characterised by thickened skin, telengiectasis with persistent facial oedema (erythrosis). A small number of these patients may progress to the next stage.

Stage III:
This stage is the stage of acne rosacea. Features of this stage include:

1. Erythematous papules
2. Pustules over forehead, glabella, malar region, nose and chin

Pustules can sometimes be seen in other areas like chest, scalp (bald areas).

According to Wilkins these stages can also be called as prerosacea, vascular rosacea and inflammatory rosacea. [6]

Stage IV:
This is the classic rhinophyma. Patients who go on to reach this stage is rather small. Nose is the most common site affected.

Other sites involved include:

Zygophyma - zygomatic area
Mentophyma - Mental area
Otophyma - involving the pinna

Gross appearance:
Nasal skin appears erythematous with telengiectasis. The skin may sometimes appear purple in color. In severe cases the skin over the nose can have pits, fissures and areas of scarring. Inspissated sebum and bacterial infection in these areas could cause foul odor to emit in these patients. Nasal tip area is preferentially enlarged. Nasal dorsum and side walls can also be enlarged but to a lesser degree.

Hypertrophy of nasal skin cause damage to the esthetic units of the face. Some of these patients may suffer from secondary nasal airway obstruction.

Clinical photograph of a patient with Rhinophyma

Tumorous growth can develop in late nodular forms of disease causing severe cosmetic deformity. Bony and cartilagenous framework are not involved in majority of these patients [7].

Mark’s hypothesis [8] regarding genesis of rhinophyma:

a. Vascular instability in the skin
b. Loss of fluid into the dermal insterstitium and matrix
c. Inflammation and fibrosis
d. Skin thickening with dermal and sebaceous gland hyperplasia
e. Dilated sebaceous gland duct become plugged with sebum
f. Cystic changes in the dilated sebaceous gland ducts

Clincal study of rhinophyma reveals the existence of two different clinical forms of the disorder. The first group demonstrated the features commonly observed in classic rhinophyma. The second group demonstrated a more severe form of the disease with a different histology. In the severe form inflammatory changes are less prominent with thickening of dermis, and thinning of epidermis. There is actual loss of observable sebacous units.

Dermal telengiectasis is more clearly seen in these patient.

Freeman's classification of rhinophyma depending on the severity of deformity:

Freeman [9] reviewing 55 patients with clinically confirmed rhinophyma devised a 5 stage classification depending on the severity of deformity.

1. Early vascular type

2. Diffuse enlargement - Moderate

3. Localised tumor - Early

4. Diffuse enlargement - Extensive

5. Diffuse enlargement - Extensive with localised tumor

Wiemer [9] suggested that facial flushing which is a feature of Rhinophyma could be due to consumption of vasoactive foods and drinks (which include alcohol) could be a coincidence and not an etiological factor. Bacterial colonization along with plugged sebaceous glands have been consistently demonstrated in patients with acne rosacea. This prompted Anderson to postulate a link between Demodex Folliculorum and acne rosacea in 1932 [9]. Focus on infective etiology as a causative factor for rhinopyma still continues, Helicobacter Pylori has been implicated because many of these patients complained of gastrointestinal disturbances. The current consensus is that this hypothesis has no scientific merit [10]. Cutaneous malignancies can go unnoticed in these patients. Squamous cell carcinoma, sebaceous carcinoma and angiosarcoma have been reported in these patients.

Management:

Aggressive management of acne rosacea may go a long way in reducing the incidence of rhinophyma in these patients. Currently oral / topical antibiotics and retenoids are the main stay in managing these patients.

1. Regular facial massage: This helps in the reduction of facial oedema.

2. Avoidance of consumption of too hot / too cold drinks

3. Avoidance of alcohol

4. Topical use of metronidazole (first line of management)

5. Topical azelaic acid (known to reduce bacterial colonization and decreased production of keratin)

6. Topical apha 2 agonist Brimonidine can be used to manage eruthema associated with acne rosacea

7. Topical ivermectin has been approved by FDA for treatment of inflammatory lesions associated with rosacea [13].

8. Oral contraceptives can be used in patients who provide history of worsening rosacea with their hormonal cycle

9. Dapsone can also be used to treat severe and refractory forms of rosacea

10 Tacrolimus ointment: It reduces itching and inflammation by suppressing the release of cytokines from T cells.

11. Tetracycline and Doxicycline can be used as antibiotics in these patients

Role of surgery:

Surgery is indicated in severe cases of rhinophyma not responding to conventional medical therapy. The lesion is excised taking care to preserve perichondrium. Raw area can be reconstructed using full thickness skin graft. Preservation of perichondrium goes a long way in preventing scar formation. Excision of the lesion can be performed using carbondioxide laser / scalpel excision / dermabrasion / Weck razor excision. Currently coblation technology is being attempted with good results. This procedure inaddition to providing excellent bleeding control causes very little collateral damage thereby reducing scar tissue formation [14].

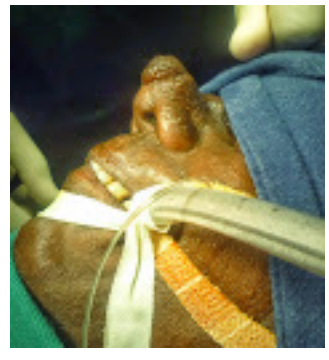


Figure showing intubated patient before surgery

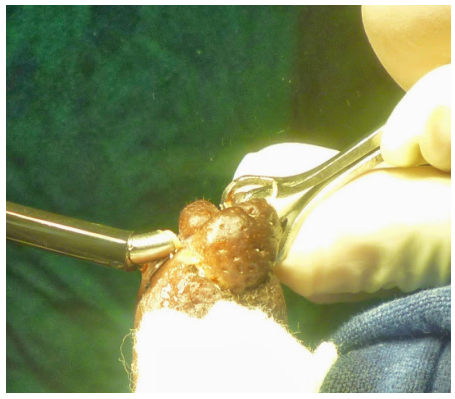


Figure showing lesion being held and ablated using coblation wand

Figure showing the result after ablation of the lesion

After ablation of the lesion, split thickness skin graft can be used to cover the lesion

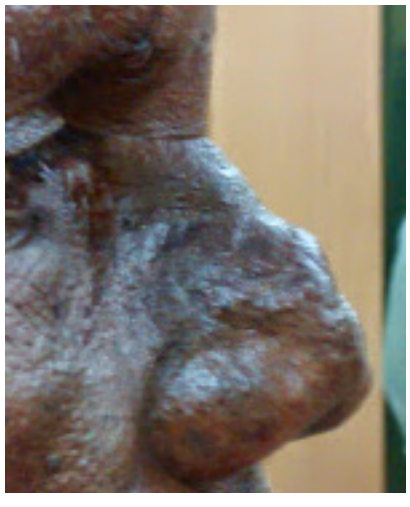


Figure showing the result 3 months following surgery

Conclusion:

Author has operated about 3 patients using this technology with satisfactory results. Long term study is needed to validate the observations.

References:

1. Zane R. Rhinophyma [database on the Internet]. Houston: Baylor College of Medicine. c1992 [updated 2006 Feb 15]. Available from: http://www.bcm.edu/oto/grand/102992.html

2. Tope W, Sangueza O. Rhinophyma's fibrous variant. Histopathology and immunohistochemistry. American Journal of Dermatopathology.1994; 16(3): 307-10.

3.Wiemer, D. R. Rhinophyma. Clin. Plast. Surg. 14: 357, 1987.

4. Elliott, J. G., Jr., Hoehn, J. G., and Stayman, J. W., III. Rhinophyma: Surgical refinements. Ann. Plast. Surg. 1: FIG. 6. Preoperative and 1-year postoperative views. 298, 1978.

5. Rebora, A. Rosacea. J. Invest. Dermatol. 88(Suppl.): 56s, 1987

6. Wilkin, J. K. Rosacea: Pathophysiology and treatment. Arch. Dermatol. 130: 359, 1994

7. Freeman, B. S. Reconstructive rhinoplasty for rhinophyma. Plast. Reconstr. Surg. 46: 265, 1970.

8. Marks, R. Concepts in the pathogenesis of rosacea. Br. J. Dermatol. 80: 170, 1968

9. Ayers, S., Jr., and Anderson, N. P. Demodex folliculorum: Its role in the etiology of acne rosacea. Arch. Dermatol. Syphilol. 25: 89, 1932

10. Bamford, J. T., Tilden, R. L., Blankush, J. L., and Gangeness,D.E. EffectoftreatmentofHelicobacter pylori infection on rosacea. Arch. Dermatol. 135: 659, 1999

11. Wiemer, D. R. Rhinophyma. Clin. Plast. Surg. 14: 357, 1987

12. Freeman, B. S. Reconstructive rhinoplasty for rhinophyma. Plast. Reconstr. Surg. 46: 265, 1970.

13. Stein L, Kircik L, Fowler J, et al. Efficacy and safety of ivermectin 1% cream in treatment of papulopustular rosacea: results of two randomized, double-blind, vehicle-controlled pivotal studies. J Drugs Dermatol. 2014 Mar. 13(3):316-23. [Medline]

14. Hetherington HE. Coblation-assisted decortication for the treatment of rhinophyma. Laryngoscope. 2009;119:1082–4. [PubMed: 19358247]

Role of coblation in the management of oropharyngeal hemangioma

Introduction:

Hemangiomas are the most common tumors of head and neck seen in children. Tongue and floor of the mouth are the most common sites [1]. They are present at birth, gradually increase in size and resolves either partially or completely when the child reaches the age of 7. Although these lesions are adhered to the parenchyma, there is no direct involvement of parenchyma. In fact they do not contain tissue of the organ to which they are attached. Cavernous hemangiomas are the most common type encountered.

Pathophysiology of Hemangiomas:

Developmentally three stages have been observed in vascular system differentiation.

First stage:(Capillary network stage)
This stage consists of interconnected blood lakes with no identifiable arterial or venous channels.

Second stage:(Retiform stage)
This stage is characterised by development of separate venous and arterial stems on either side of the capillar network

Final stage: (Mature stage)
This stage occurs within the first few months of life and involves gradual replacement of the immature plexiform networks by mature vascular channels.

Capillary hemangioma is more common and it represents an arrest in the development at the capillary network stage. Arrest of development during the second stage of development of vascular system (retiform stage) may produce venous, arterial or capillary malformations.

Classification of hemangiomas:
Hemangiomas are classified into capillary, cavernous and combined varieties.

Capillary hemangiomas (strawberry lesion)
Usually appears as red papular lesion, commonly with a lobulated surface. Its rate of proliferation is alarming at birth, but involution tends to begin during the 7th month of life.

Cavernous hemangiomas:
These may remain in the subcutaneous / submucous plane. These lesions are smooth, poorly defined and compressible. On palpation they resemble a bag of worms.

They have a tendency to increase in size when the child cries. Notoriously these hemangiomas do not involute fully and leave behind significant morbidity.

Image showing hemangioma of tongue

Most of these hemangiomas are developmental in origin and commonly contain both hemangiomatous and lymphangiomatous components. They are more common in women.

Cavernous hemangiomas of head and neck region are currently being renamed as vascular malformations. In contrast to hemangiomas these vascular malformations do not regress with age and may infact increase in size. Vascular malformations are congenital lesions, sometimes may become apparant only later in life due to progressive increase in size due to increased intraluminal blood flow. These vascular malformations usually do not involute, and their growth rate may be influenced by factors like trauma, infection and hormonal changes.

Classification of vascular malformations:

This is based on the predominant vessel type [2]:

1. Capillary

2. Venocapillary

3. Venous

4. Lymphatic

5. Arterial

6. Mixed

Management:

Systemic corticosteroids happens to be the first line of therapy even for most complicated hemangiomas. Standard regimen include 2-4 mg / kg prednisolone per day for 2 weeks and the drug should be tapered before discontinuing the same. Mechanism of action has been poorly understood.

Interferon / Vincristine can be tried in patients who are not responding to prednisalone therapy.
Mechanism of action of propranalol is that as a Beta adrenergic agonist it results in vasoconstriction causing color change and softening of the mass even during the first day of therapy.

If medical management fails then surgical excision is the treatment of choice for cavernous hemangioma. Surgical options include:

1. Laser surgery

2. Sterotactic radiosurgery

3. Injection of sclerosing agents

4. Cryotherapy

5. Coblation

Cobaltion technology has its own inherent advantages. It not only ablates hemangiomatous tissue but also causes very minimal collateral damage. There is also no risk of air way fire as is the case with laser.

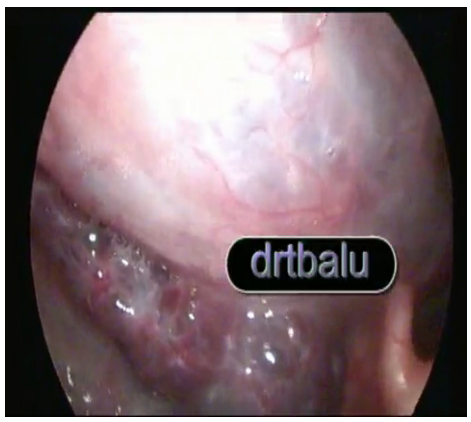


Image showing hemangioma involving posterior third of tongue and extending up to right pyriform fossa

While performing excision / ablation of hemangioma involving posterior third of tongue and pyriform fosssa, the patient is put in tonsillectomy position under general anesthesia. Bulk of the ablation is proceeded with the use of Evac 70 tonsil wand, while difficult to reach areas like the pyriform fossa is accessed using laryngeal wand.

Figure showing Tonsil wand in action

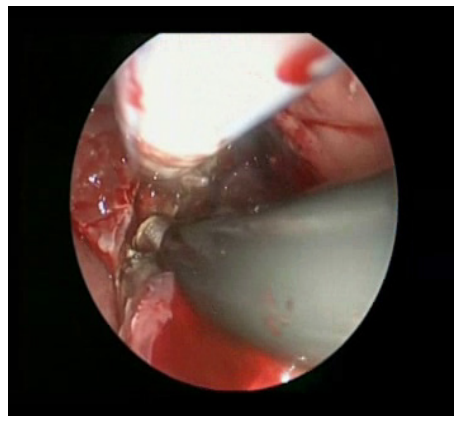


Figure showing progress of ablation of hemangioma

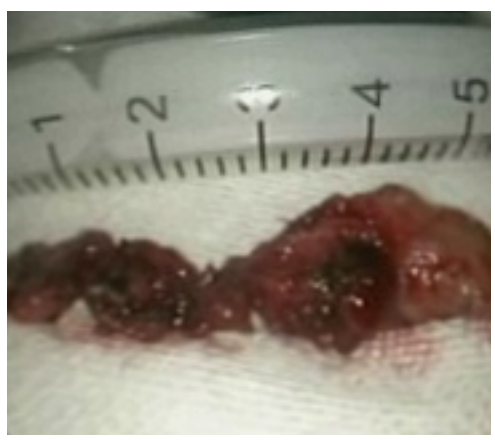


Figure showing excised gross specimen

Hemangiomas can be assocaited with various syndromes. These include:

Rendo-Osler-Weber syndrome [3]:

Autosomal dominantly inherited. Clinical features include:

Multiple telengiectasis, GI tract involvement and occasional CNS invovlement. This syndrome commonly affects blood vessels causing dysplastic changes with a tendency to bleed.

Sturge-Weber-Dimitri syndrome:

Also known as encephalotrigeminal angiomatosis.
This condition is non familial and non inherited condition featured by portwine stain, and leptomeningeal angiomas.

Von Hippel-Lindau syndrome:

Genetic transmission with variable inheritance. This syndrome is characterised by hemangiomas of cerebellum / retina with presence of cystic lesions in viscera.

All patients with hemangiomas should undergo complete evaluation to rule out associated syndromes before taking up for surgical management.

Conclusion:
Author's expericence on the use of coblation in managing hemanigomas is rather limited. Two cases were managed using this technology rather effectively. Future experiences may reveal more on this technology.

References:

1. Hibbert J. Oral cavity. In: Hibbert J, editor.Scott- Brown's otolaryngology. Laryngology and head and neck surgery. Chap. 3. Vol. 5.6th ed. Oxford: Butterworth- Heinemann. p. 1-32, 1997.

2. Enjolras O, Mulliken JB, Wassef M, et al. Residual lesions after Kasabach-Merritt phenomenon in 41 patients. J Am Acad Dermatol. 2000;42(2 pt 1):225–235

3. Giordano P, Lenato GM, Suppressa P, Lastella P, Dicuonzo F, Chiumarulo L, et al. Hereditary hemorrhagic telangiectasia: arteriovenous

malformations in children. J Pediatr. 2013 Jul. 163(1):179-86.e1-3.